OZONE MODELING FOR THE NORTHEAST TEXAS EARLY ACTION COMPACT

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1. INTRODUCTION

BACKGROUND

The Texas Commission on Environmental Quality (TCEQ) monitors air quality in Northeast Texas to determine whether the region is in compliance with EPA's National Ambient Air Quality Standards (NAAQS) for ozone. Historically, ozone levels in Northeast Texas have been close to the level of the ozone NAAQS and the region comprising Gregg, Harrison, Rusk, Smith and Upshur Counties has been considered a "near-nonattainment area" (NNA). With the assistance of funding from the State legislature, a local stakeholder group called North East Texas Air Care (NETAC) has conducted scientific studies and developed control strategies to reduce ozone levels. Ozone levels are reduced by controlling emissions of ozone precursors, namely nitrogen oxides (NOx) and volatile organic compounds (VOCs). NETAC's activities lead to the recent submission of a revised State Implementation Plan (SIP) for 1-hour ozone in Northeast Texas (TNRCC, 2002). The 1-hour SIP revision enforces significant emissions reductions that were entered into on a voluntary basis by several local industries, namely American Electric Power (AEP), Eastman Chemical Company, Texas Operations and TXU.

EARLY ACTION COMPACT

On December 20, 2002, NETAC signed an Early Action Compact (EAC) for 8-hour ozone. The objective of the EAC is to develop and implement a Clean Air Action Plan that includes emission reductions needed to demonstrate attainment of the 8-hour ozone standard by 2007 and maintain the standard beyond that date. Since the EAC was initiated, monitoring data show that Northeast Texas has come into compliance with the 8-hour ozone standard. By continuing with the EAC, NETAC is developing additional strategies to bring the region further into compliance with the EPA's 8-hour ozone standard and protect air quality in the region through at least 2012.

The EAC has a series of milestones that track progress toward developing a Clean Air Action Plan (CAAP) and then a State Implementation Plan (SIP) revision for the region. Key milestones for the Northeast Texas EAC are shown in Table 1-1. Ozone modeling plays a critical role in developing the CAAP because modeling is used to:

- Estimate whether Northeast Texas should expect to attain the 8-hour ozone standard in 2007.
- Quantify the effectiveness of emissions control strategies in reducing ozone.
- Identify control measures that will be needed to demonstrate attainment of the 8-hour ozone standard by 2007.

This report describes the ozone modeling that was completed for the CAAP.

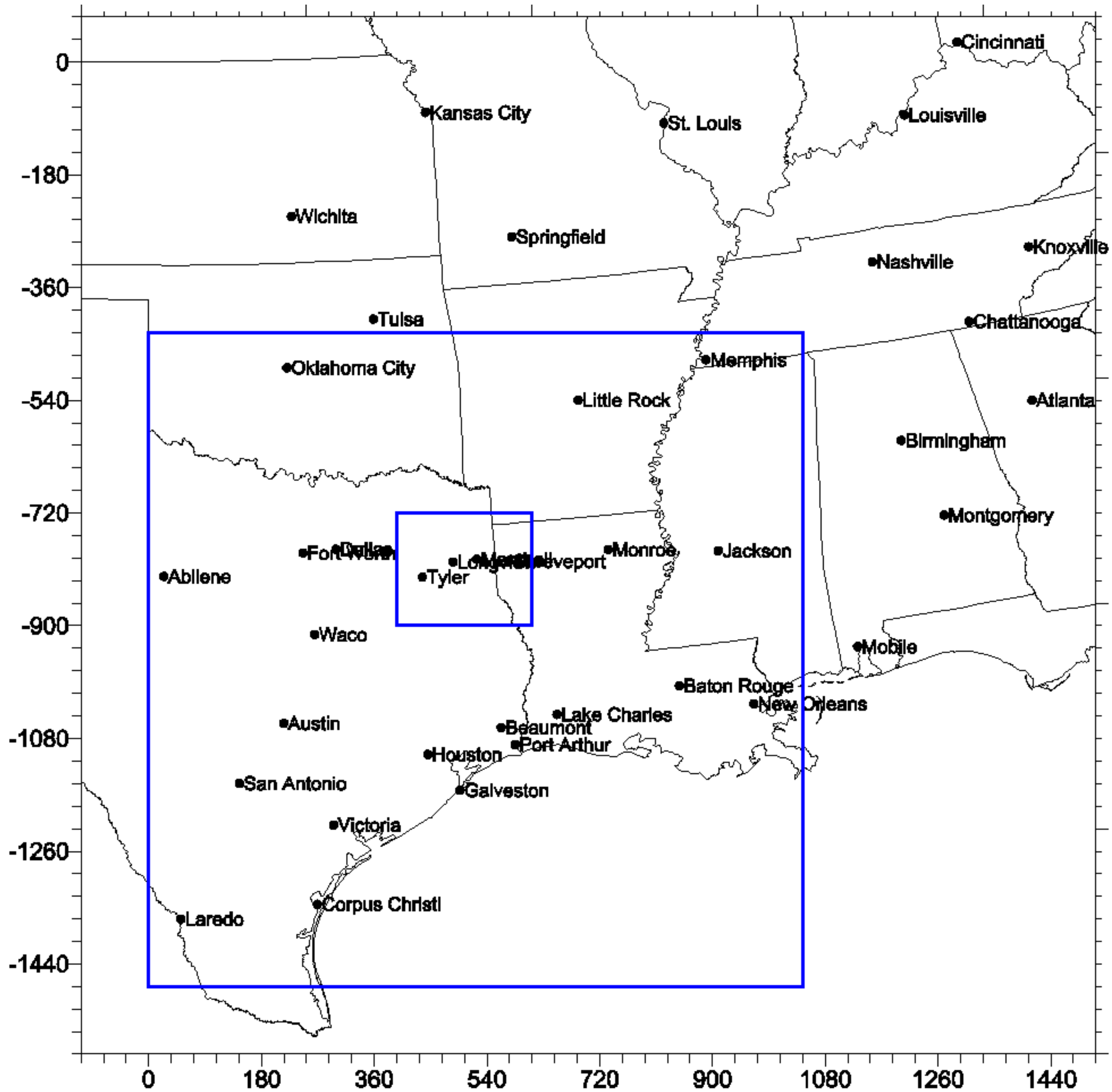
Table 1-1. Key milestone dates for the Northeast Texas Early Action Compact (EAC).

Date	Item
December 31, 2002	Signed EAC agreement
June 16, 2003	Identify/describe potential local emission reduction strategies
November 30, 2003	Initial modeling emission inventory completed Conceptual model completed Base case (1999) modeling completed
December 31, 2003	Future year (2007) emission inventory completed Emission inventory comparison for 1999 and 2007 Future case modeling completed
January 31, 2004	Schedule for developing further episodes completed Local emission reduction strategies selected One or more control cases modeled for 2007 Attainment maintenance analysis (to 2012) completed Submit preliminary Clean Air Action Plan (CAAP) to TCEQ and EPA
March 31, 2004	Final revisions to 2007 control case modeling completed Final revisions to local emission reduction strategies completed Final attainment maintenance analysis completed Submit final CAAP to TCEQ and EPA
December 31, 2004	State submits SIP incorporating the CAAP to EPA
December 31, 2005	Local emission reduction strategies implemented no later than this date
December 31, 2007	Attainment of the 8-hour ozone standard

MODELING OVERVIEW

The high 8-hour ozone period selected for modeling was August 15th-22nd, 1999. After including 2 additional days to "spin up" the ozone model, this meant modeling the 10 day period August 13th-22nd, 1999. This period was selected based on a conceptual model and episode selection for Northeast Texas, which is summarized in Section 2 of this report. The conceptual model (Stoeckenius and Yarwood, 2004) showed that this August 1999 episode is representative of typical high 8-hour ozone periods in Northeast Texas.

The modeling procedures and modeling domain were developed in an ozone modeling protocol for the August 1999 episode (ENVIRON, 2003). The Comprehensive Air Quality Model with extensions (CAMx) was selected for ozone modeling using the nested-grid modeling domain shown in Figures 1-1 and 1-2.



CAMx GRID DIMENSIONS
LCP Grid with reference origin at (40 N, 100 W)

36 km Grid: 45 x 46 cells from (-108, -1584) to (1512, 72)
12 km Grid: 87 x 87 cells from (0, -1476) to (1044, -432)
4 km Grid: 54 x 45 cells from (396, -900) to (612, -720)

(nested grid dimensions do not include buffer cells)

Figure 1-1. CAMx modeling domain for the August 1999 episode showing the 36-km regional grid and the nested 12-km and 4-km fine grids.

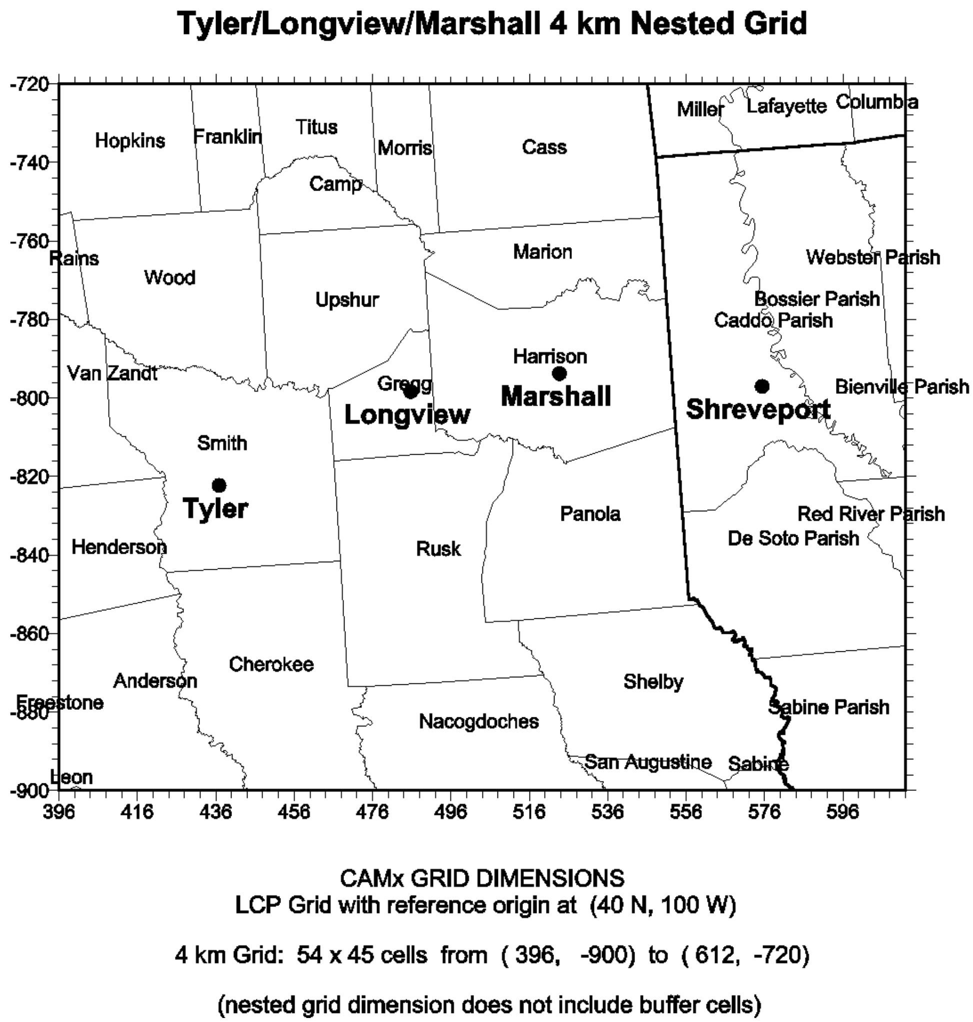


Figure 1-2. CAMx 4 km fine grid covering Northeast Texas for the August 1999 episode.

OZONE LEVELS IN NORTHEAST TEXAS

The TCEQ operates several continuous air monitoring stations (CAMS) in Northeast Texas as shown by the map in Figure 1-3. Historically, the highest ozone concentrations have been recorded at the Longview monitor (CAMS-19) located at the Gregg County airport where ozone data have been collected since the 1970s. Ozone monitoring commenced in 1995 at Tyler Airport (CAMS-86) although the monitor was relocated within the airport in 2000 due to construction and assigned a new number (CAMS-82). A monitoring site was established toward the east of the region at the Cypress River Airport (CAMS-50) in 1998. Cypress Riveris located to the north of Marshall in Marion County, which is not part of NETAC. The Cypress River monitor was discontinued in March 2001 and a new site located across the county line in Harrison County (Karnack, CAMS-85) began operating in September 2001. The CAMS 605 monitor was discontinued in October 2001 and the CAMS 133 monitor was discontinued in April 1991.

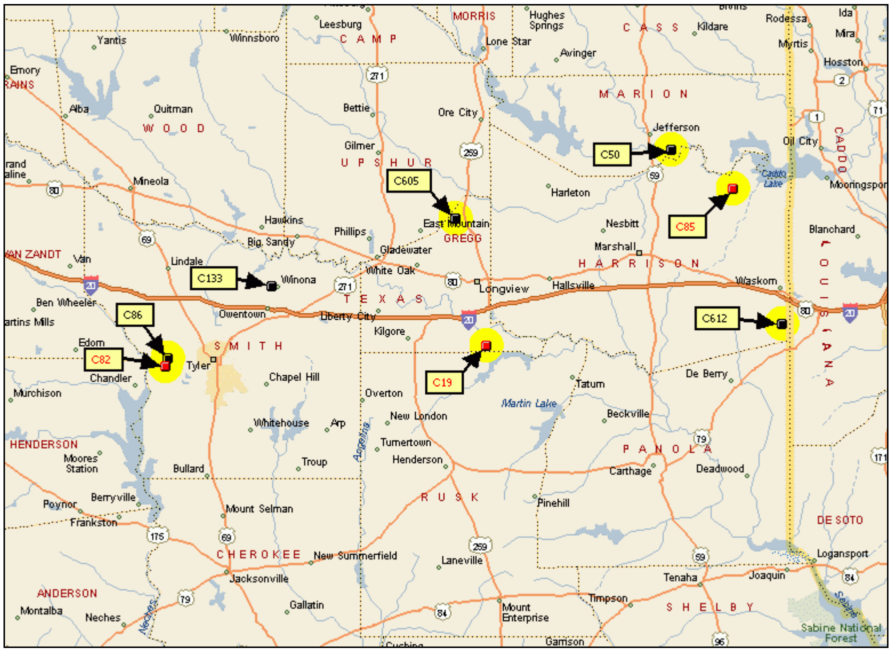


Figure 1-3. Location of Continuous Air Monitoring Stations (CAMS) operated by the TCEQ in Northeast Texas. CAMS 19, 82 and 50 were active in August 1999.

Ozone trends for 1995 – 2002 at Longview and Tyler are compared with Dallas and Shreveport in Figure 1-4. This Figure shows annual 8-hour design values i.e., the 4th highest 8-hour ozone for the year. The data for Shreveport are based on the maximum of the Caddo and Bossier parish design values; annual 8-hour design values for Dallas are based on the maximum over five sites for which valid design values were available in each year. Trends at all locations share similar features. The annual design value in Dallas is higher than at the other locations in every year except 1998 and, in contrast to annual design values in Northeast Texas and Shreveport, did not drop off significantly in 2001 and 2002. Annual design values at Longview were comparable to those in Dallas during 1998 – 2000 but were much lower (and instead comparable to those at Tyler and in Shreveport) in 1996-1997 and 2001-2002.

NETAC has undertaken research monitoring to collect ozone data at additional locations and supplemental precursor data at TCEQ monitoring locations. The NETAC research-monitoring site was located at Waskom in eastern Harrison County for the 2002 and 2003 ozone seasons and data were reported via the TCEQ's data system as CAMS-612, which is shown in Figure 1-3.

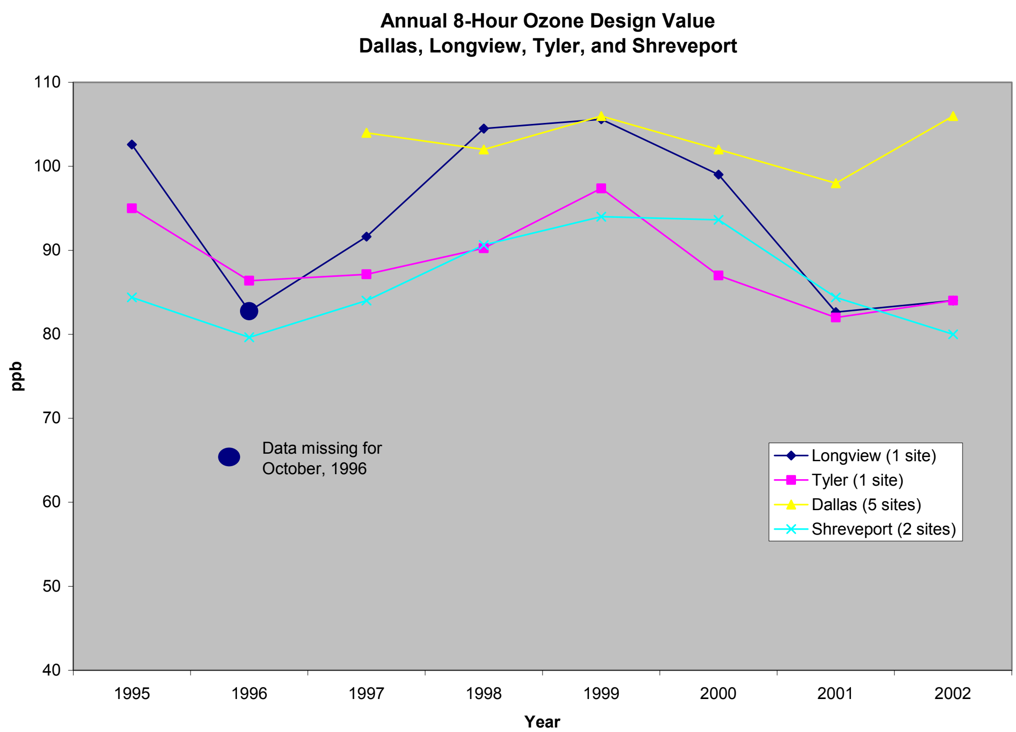


Figure 1-4. Annual 8-hour ozone design values at locations in Northeast Texas, Dallas, and Shreveport, LA.

The annual fourth highest daily maximum 8-hour ozone values for 2001 to 2003 are shown in Table 1-2 for monitors in Northeast Texas. The Karnack and Waskom monitors have only 2 years of data and so will not be used by EPA in attainment designations based on 2001 to 2003 data. Two-year design values are shown for Karnack and Waskom because they are used in the ozone attainment demonstration modeling (Section 6) and for comparison with Longview and Tyler. The preliminary 2001-2003 8-hour ozone design values for Longview and Tyler are both below 85 ppb and so Northeast Texas is monitoring attainment of the 8-hour standard.

Table 1-2. Annual fourth highest daily maximum 8-hour ozone values and preliminary 2001-2003 8-hour ozone design values for Northeast Texas.

Year	Longview	Tyler	Karnack	Waskom
2001	82	82	Partial Season	Not Operating
2002	84	84	88	86
2003	82	79	80	82
Design Value	**82**	**81**	**(84)**	**(84)**

Notes: The two-year design values for Karnack and Waskom are not used for attainment designation.

REPORT ORGANIZATION

Section 2 of this report describes the selection of the August 1999 modeling episode. The preparation of ozone model inputs is described in Sections 3 through 5 of this report. Section 3 describes the emission inventory development for the 1999 base year and 2002 and 2007 future years. Section 4 summarizes the meteorological modeling and extensive details are given in two supporting reports. Section 5 describes the preparation of other CAMx inputs.

Section 6 describes the development of the 1999 base case including model evaluation procedures, diagnostic tests and sensitivity tests. The 1999 base case was refined through a series of improvements to the meteorology, emissions and CAMx inputs. The final 1999 base case was “base case7”. The 2007 base case was developed to evaluate future attainment of the ozone NAAQS. The final 2007 base case was “07base5.” The summary and conclusions at the end of Section 6 include recommendations for the next steps in EAC ozone modeling for Northeast Texas.

Section 7 describes a detailed evaluation of which emissions sources were primarily responsible for high 8-hour ozone levels in Northeast Texas during the August 1999 episode. This analysis used the ozone source apportionment technology (OSAT) tools available on CAMx.

2. EPISODE SELECTION

An episode selection analysis was performed to identify a period with representative high 8-hour ozone levels that was suitable for regional ozone modeling (ENVIRON, 2000). This analysis was reviewed and updated in developing a conceptual model for 8-hour ozone in Northeast Texas (Stoeckenius and Yarwood, 2004). The conceptual model concluded that the August 1999 episode selected for modeling remains a representative and appropriate choice.

EPISODE SELECTION PROCEDURE

Ozone data for Northeast Texas monitors from 1995 through 1999 were reviewed along with meteorological data such as back-trajectories and daily weather maps (ENVIRON, 2000). Episodes suitable for developing a new RSM for 8-hour ozone in Northeast Texas were identified by the following criteria:

- Choose periods from the most recent three years at that time, i.e. 1997 to 1999.
- Choose a multi-day period with 3 or more "high ozone" days as defined below.
- Choose a period with high ozone at both Longview and Tyler. Based on the EPA draft modeling guidance (EPA, 1999) and the 1997-1999 design values, high ozone was considered to be an 8-hour value of 85 - 101 ppb at Tyler, and 90 - 110 ppb at Longview.
- Choose a period with representative meteorological conditions for 8-hour ozone, which is stagnation in Northeast Texas associated with a high regional ozone background and transport at the beginning of the stagnation period. This type of event is often referred to as a "regional haze event" because it is associated with hazy air across the whole East Texas region.
- Availability of supporting meteorological data, in particular data from the NCEP EDAS model, is a strong advantage for modeling. EDAS data are available since 1997 with occasional missing days or blackout periods.
- Availability of special air-quality data, such as Baylor Aircraft flights and NETAC monitoring studies, is an advantage.

A search through 1997 to 1999 using these selection criteria listed above identified four candidate episodes:

1. August 26 to Sept 4, 1998
2. August 2 to August 7, 1999
3. August 15 to August 22, 1999
4. September 15 to September 20, 1999

The August/September 1998 period was given the lowest priority because important supporting meteorological data (the NCEP EDAS analyses) are missing for most of this period.

In selecting between the remaining two candidate periods, the August 1999 episode was given the highest priority for modeling because the September 1999 episode appears atypical and may be difficult to model for Northeast Texas. Specifically:

- The meteorology during the September 1999 episode appears to be unusual for high ozone episodes in Northeast Texas.
  - Temperatures were unusually cool for a Northeast Texas ozone episode. Maximum temperatures at Longview were mostly in the mid 80's rather than the high 90's.
  - Upper level winds were from the west and unusually strong in the mid-troposphere (about 5 km altitude).
  - Widespread daily rainfall occurred in North Texas and Oklahoma. Archived NEXRAD data show rainfall in the area between Dallas to Shreveport on 4 of the 5 high ozone days.

- An unusual ozone episode (such as September 1999) is not a good choice as the cornerstone of 8-hour ozone control strategy development efforts.

- Some of the unusual meteorological factors mentioned above are also likely to make this a difficult period to model successfully for Northeast Texas. There is a greater risk of the September 1999 episode performing poorly in Northeast Texas than the August 1999 episode.

OZONE LEVELS FOR AUGUST 15-22, 1999

An August 15 – August 22, 1999 ozone episode was selected for evaluating 8-hour ozone in Northeast Texas (Stoeckenius et al., 2004). The modeling period was expanded to August 13 – August 22, 1999 to include 2 spin-up days before the start of the episode to reduce the influence in the modeling of initial conditions. As discussed below, this period includes combined influences from a high regional ozone background and local emissions, and includes a complete cycle of transport winds followed by local stagnation returning to transport winds at the end of the episode. This is a typical pattern for high 8-hour ozone events in Northeast Texas (Stoeckenius et al., 2004).

The ozone data recorded at Continuous Air Monitoring Stations (CAMS) in Northeast Texas during this period are shown in Table 2-1. High ozone levels were recorded at all three CAMS during this period. On August 18th and 19th the ozone levels were similarly high at all three sites consistent with a high regional background of ozone. These high ozone levels built up between August 15th and 17th. This is consistent with the onset of meteorological stagnation on August 16th continuing through August 18th. Because the ozone-monitoring network in Northeast Texas is relatively sparse, the highest ozone levels on August 16th-18th may not have been recorded by a monitor. Ozone levels at Longview and Cypress River declined on August 20th and 21st, but then increased again on August 22nd. The pattern at Tyler is different on these days with higher ozone at Tyler on August 20th and 21st than on August 22nd.

Table 2-1. Maximum ozone levels and temperatures for the August 1999 episode days.

Date	Longview Maximum Temperature (ºF)	Max 8-hour Ozone (ppb)		
		Longview CAMS 19	Tyler CAMS 82	Cypress River CAMS 50
8/15/99	93	66	73	55
8/16/99	95	105	92	71
8/17/99	96	110	97	90
8/18/99	99	88	74	91
8/19/99	102	91	85	81
8/20/99	97	80	86	70
8/21/99	95	87	92	67
8/22/99	96	91	77	82

Longview had especially high ozone monitored levels on August 16th and 17th that were significantly higher than at Tyler or Cypress River on these days consistent with a localized influence at Longview superimposed on the high regional background. There also are indications that Tyler experienced localized ozone impacts on August 15th, 20th and 21st because there were short periods when the ozone at Tyler spiked to higher levels than the other monitors. The localized impacts seen on some days at Longview and Tyler are consistent with plumes impacting the monitor locations. These plumes are likely to be associated with emissions sources within the Northeast Texas area and could be from either a major industrial source or an urban area.

BACK TRAJECTORIES FOR AUGUST 15-22, 1999

Local wind data for Northeast Texas are available from the TCEQ CAMS, but while these data are useful for determining the wind direction in the immediate vicinity of a monitor, they are less useful for developing a conceptual picture of regional wind patterns during an ozone episode period. One way to evaluate the regional wind patterns is from back trajectories. The National Oceanic & Atmospheric Administration (NOAA) provides web-based tools to calculate back trajectories at http://www.arl.noaa.gov/ready/hysplit4.html. The NOAA back trajectories are based on archived data from weather forecasting models, so back trajectories are models rather than observations. A single back trajectory shows how a model predicts that air moved to arrive at a fixed end point in space and time.

Back trajectories provide a simple picture of air movements to arrive at a given place and time. This picture should not be taken too literally since:

- Back trajectories are computer models with uncertainties.

- The concept of a back trajectory over-simplifies the way air moves in the real atmosphere by neglecting important effects such as vertical mixing and differences in wind speed/direction with height.

Back trajectories for days between August 16th and 22nd, 1999 are shown in Figure 2-1. These trajectories are based on archived wind data from the NOAA/NCEP Eta Data Analysis (EDAS) system. The back trajectories end at the Longview CAMS-19 monitoring site at 15:00 hours CDT (which is 21:00 hours UTC in the trajectory labeling used in Figure 2-1). Back Trajectories were run for a duration of 32 hours, i.e., back to the morning of the day before, so that they indicate about 1.5 day transport distances. Back trajectories were run for ending altitudes of 500 m and 1000 m to provide an indication of whether wind shear was important. If the 500 m and 1000 m trajectories run in different directions, this indicates that there was significant variation in winds with altitude and that the back trajectory directions are highly uncertain.

Back trajectories for August 16th through 22nd, 1999 are shown in Figure 2-1. These trajectories are based on archived wind data from the NOAA/NCEP Eta Data Analysis (EDAS) system. The back trajectories end at the Longview CAMS-19 monitoring site at 16:00 hours CDT (which is 21:00 hours UTC in the trajectory labeling used in Figure 2-1). Back Trajectories were run for a duration of 32 hours, i.e., back to the morning of the day before, so that they indicate about 1.5 day transport distances. Back trajectories were run for ending altitudes of 500 m and 1000 m to provide an indication of whether wind shear was important. If the 500 m and 1000 m trajectories run in different directions, this indicates that there was significant variation in winds with altitude and that the back trajectory directions are highly uncertain.

The back trajectories show organized but weak easterly winds on August 16th transitioning to stagnation on August 17th. The stagnation persisted through August 19th. On August 20th the back trajectories become more organized again with winds from the northeast, but the back trajectories for August 20th (and August 21st) are unusual because the 500 m trajectories travel back further than the 1000 m trajectories. The back-trajectory for August 21st suggests that there was subsidence leading up to this day. On August 22nd the trajectories return to weak easterly winds and are similar to August 16th. This pattern shows a complete cycle of an episode beginning with transport winds from the East/Northeast followed by local stagnation returning to transport winds from the East/Northeast at the end of the episode. This is a typical pattern for high 8-hour ozone events in Northeast Texas (Stoeckenius et al., 2004).

August 16-19, 1999

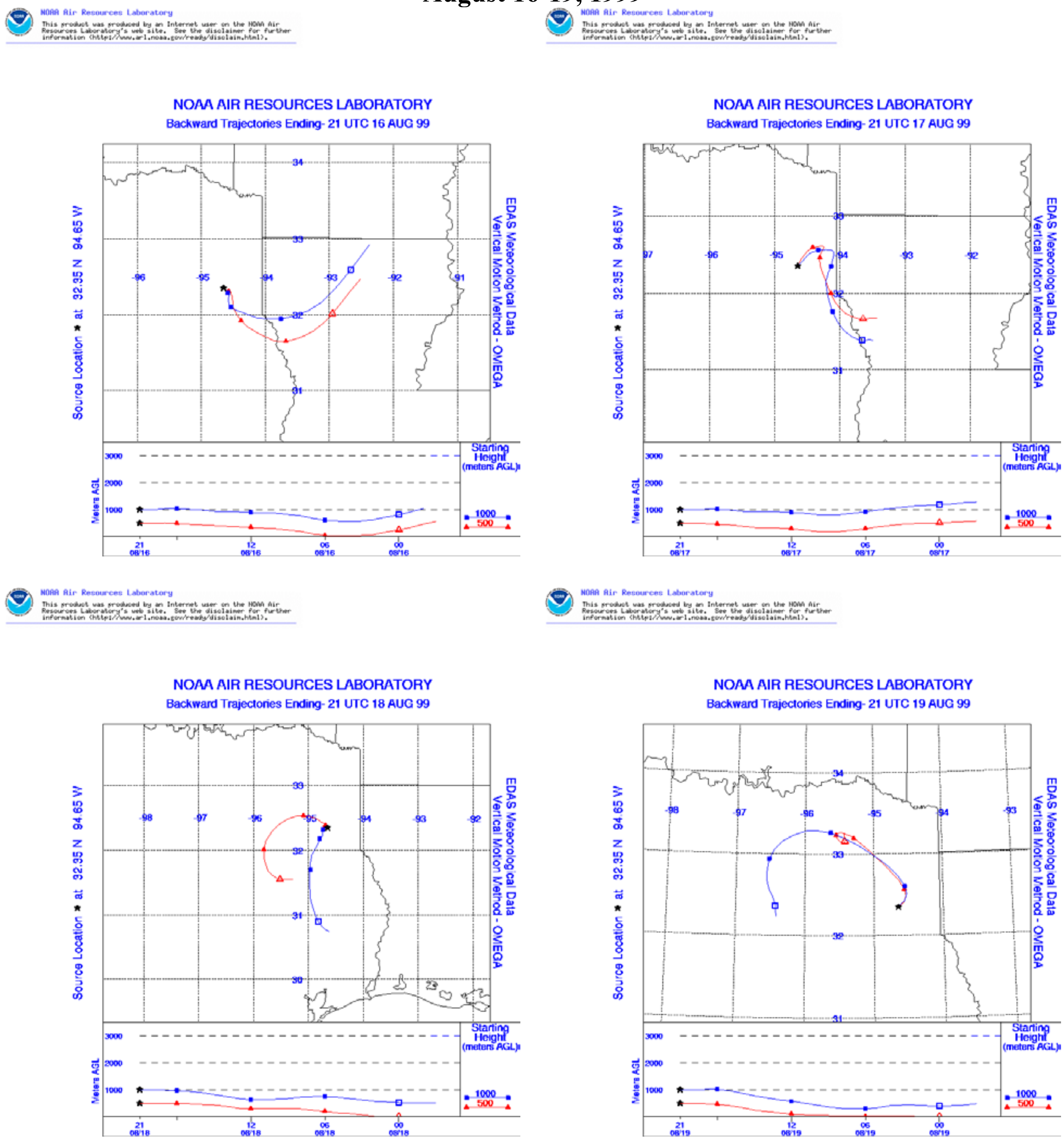
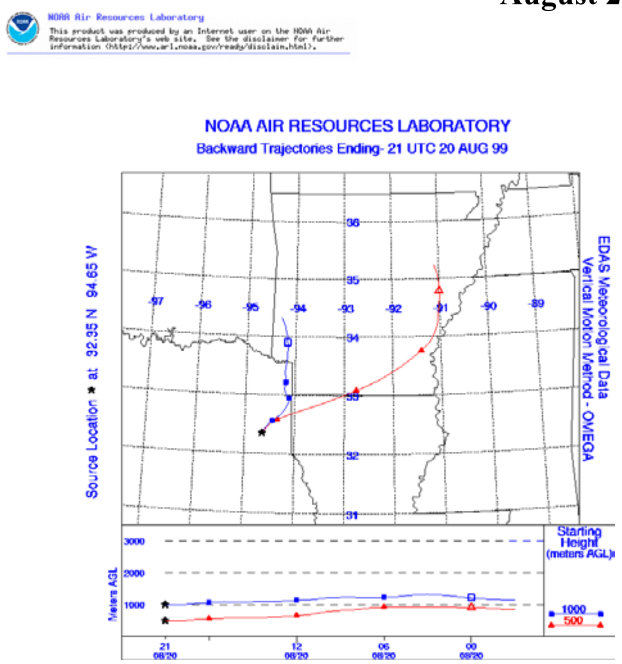
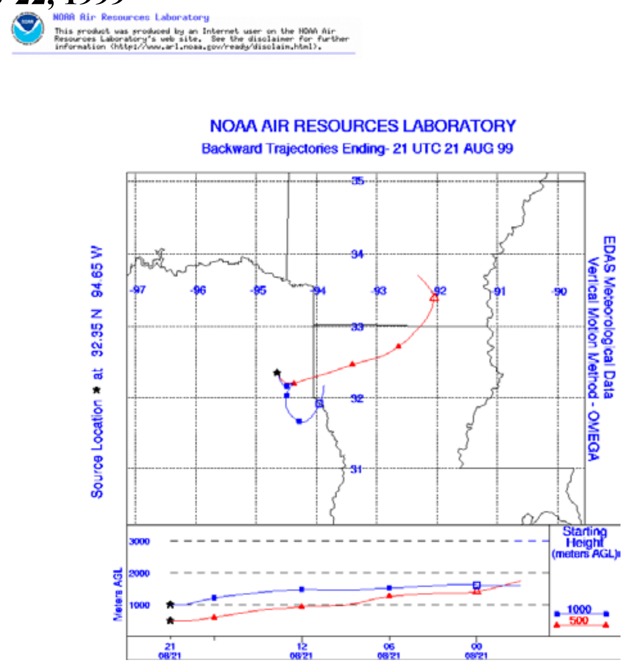


Figure 2-1. Back trajectories from Longview (CAMS19) ending at 15:00 CDT.

August 20-22, 1999





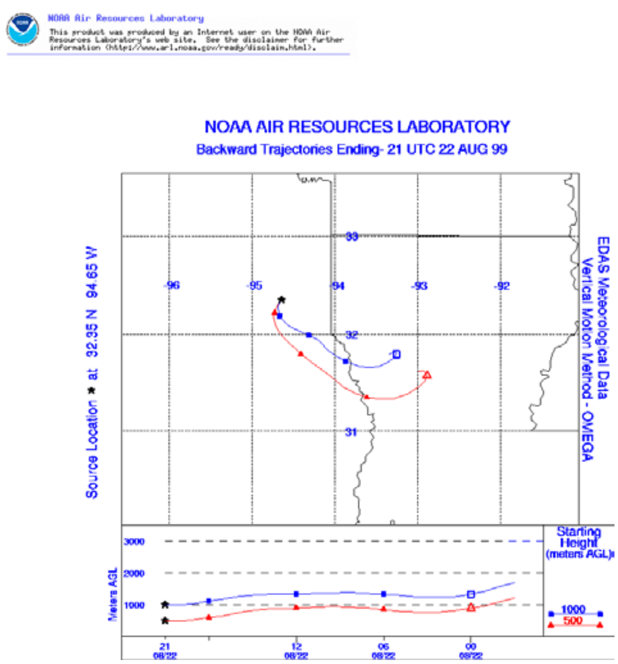


Figure 2-1 (concluded). Back trajectories from Longview (CAMS19) ending at 15:00 CDT.

BACK TRAJECTORIES PLUS OBSERVED OZONE

An analysis was carried out that combined back trajectories with observed ozone levels to investigate the potential for ozone transport. Figures were prepared that combined several types of data for a specific day:

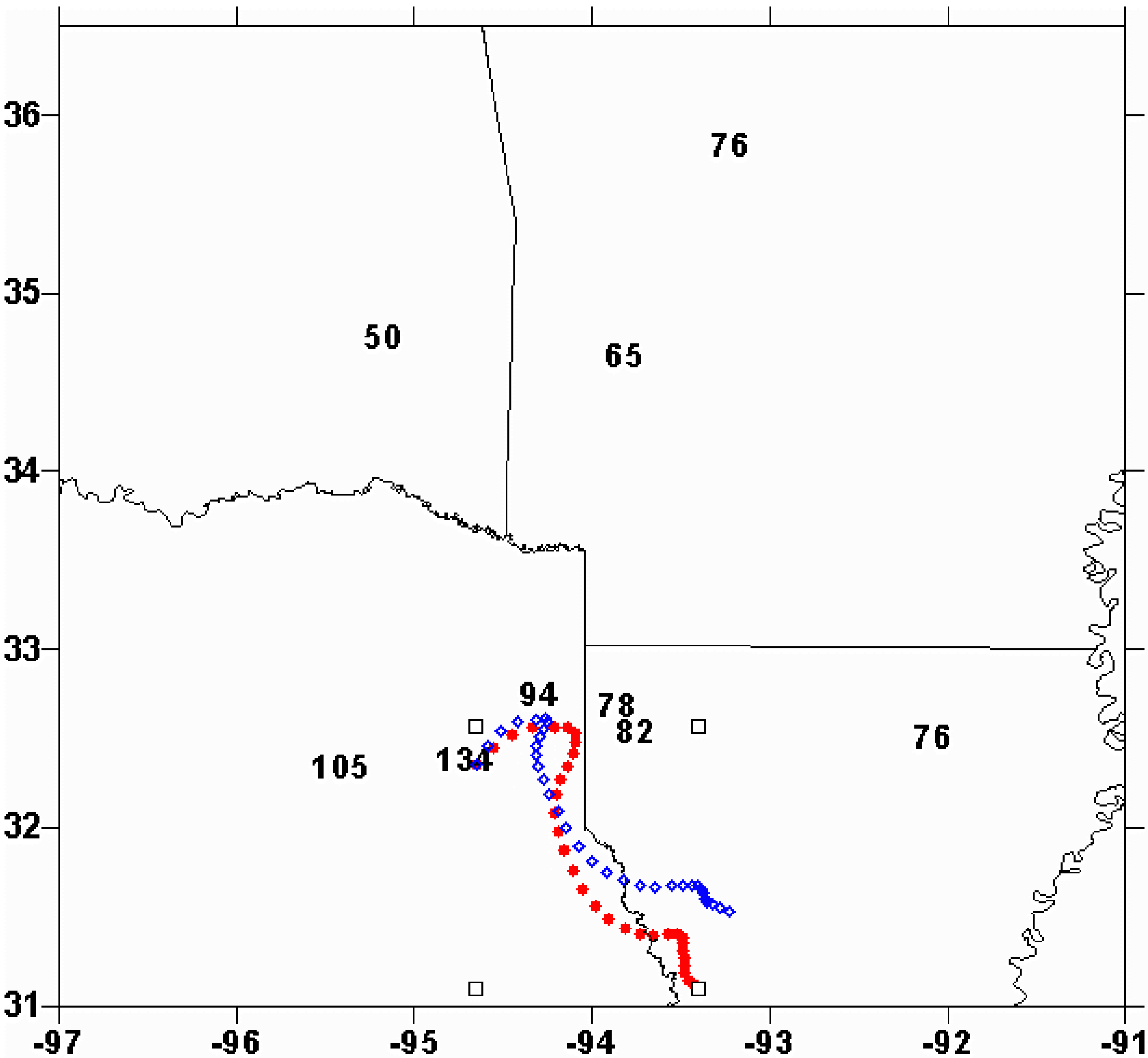
- The daily maximum 1-hour ozone levels at the Longview, Tyler and Marshall CAMS.
- The Longview back-trajectories ending at 15:00 and 500/1000 m.
- The daily maximum 1-hour ozone for the previous day in surrounding areas (Louisiana, Arkansas, Oklahoma). Previous day ozone levels are shown for the surrounding areas because the back trajectories are 1.5 days long from end (Longview) to start.

Figures 2-2 through 2-4 show these analyses for August 17th, 20th and 22nd, respectively. Limitations to keep in mind are that the back-trajectories only provide an indication of the likely transport direction and distance, and that the upwind monitored values may not represent regional ozone levels because many of them are in urban areas.

On August 17th (Figure 2-2), the back trajectories are short and meandering consistent with stagnation. Air in Northeast Texas may have been in Northwest Louisiana on the previous day Peak ozone levels in Northeast Texas on August 17th (94 ppb to 134 ppb) were much higher than in Northwest Louisiana on August 16th (78 ppb to 82 ppb), suggesting a significant contribution from local emissions to the high ozone levels in Northeast Texas on August 17th, 1999.

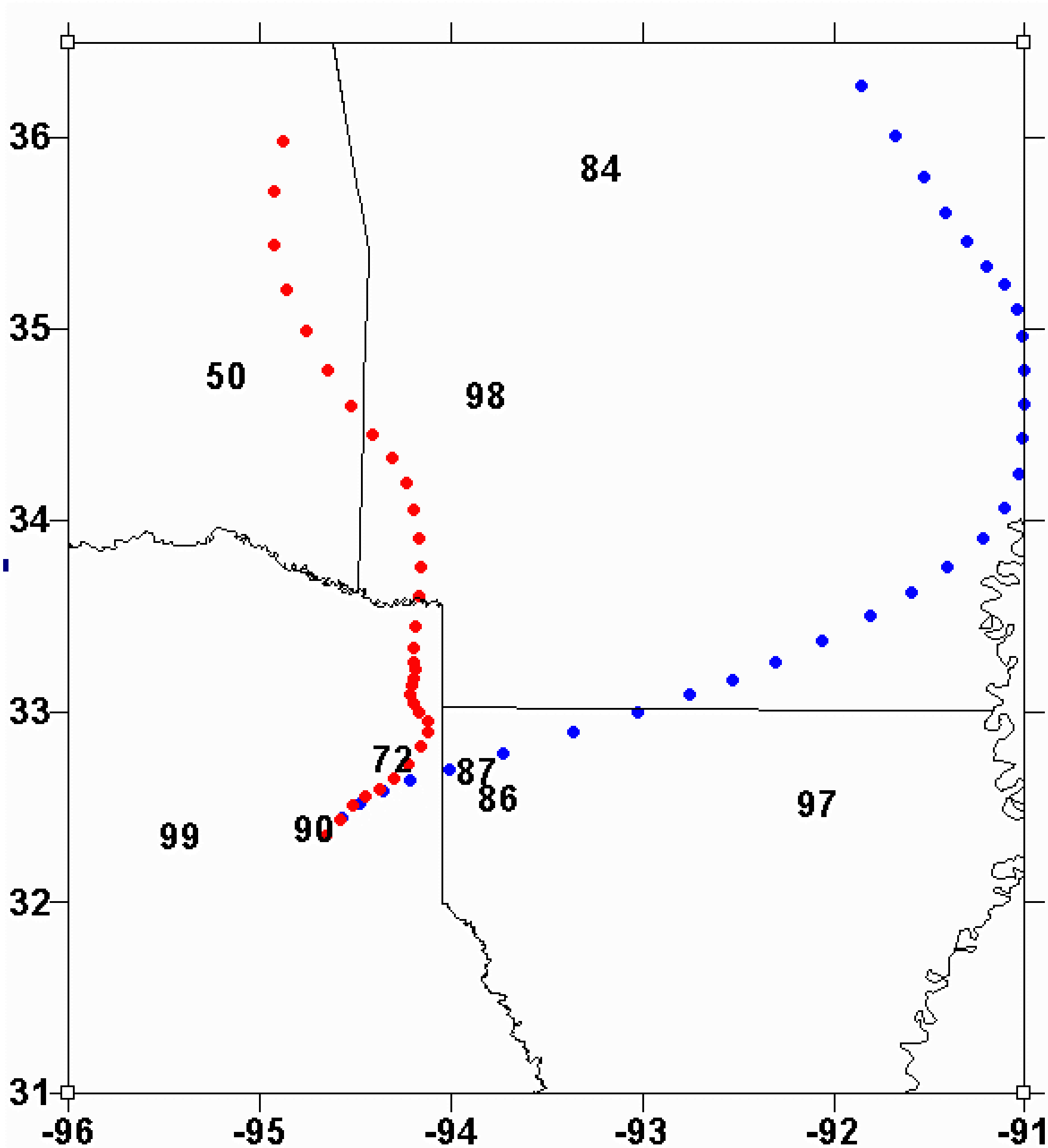
For August 20th (Figure 2-3), the back trajectories suggest that the air in Northeast Texas may have come from an area between Northern Louisiana to Western Arkansas on the previous day. Peak ozone levels in Northeast Texas on August 20th (72 ppb to 99 ppb) were similar to the levels in this upwind area on August 19th (84 ppb to 97 ppb) suggesting that the high ozone in Northeast Texas on August 20th was part of a regional high ozone event that was transported through the region.

For August 22nd (Figure 2-4), the back trajectories suggest that the air in Northeast Texas may have come from Northwest Louisiana on the previous day. Peak ozone levels in Northeast Texas on August 22nd (78 ppb to 107 ppb) were higher than the levels in Northwest Louisiana on August 21st (68 ppb to 73 ppb) suggesting a moderate contribution from local emissions to the high ozone levels in Northeast Texas on August 22nd, 1999.



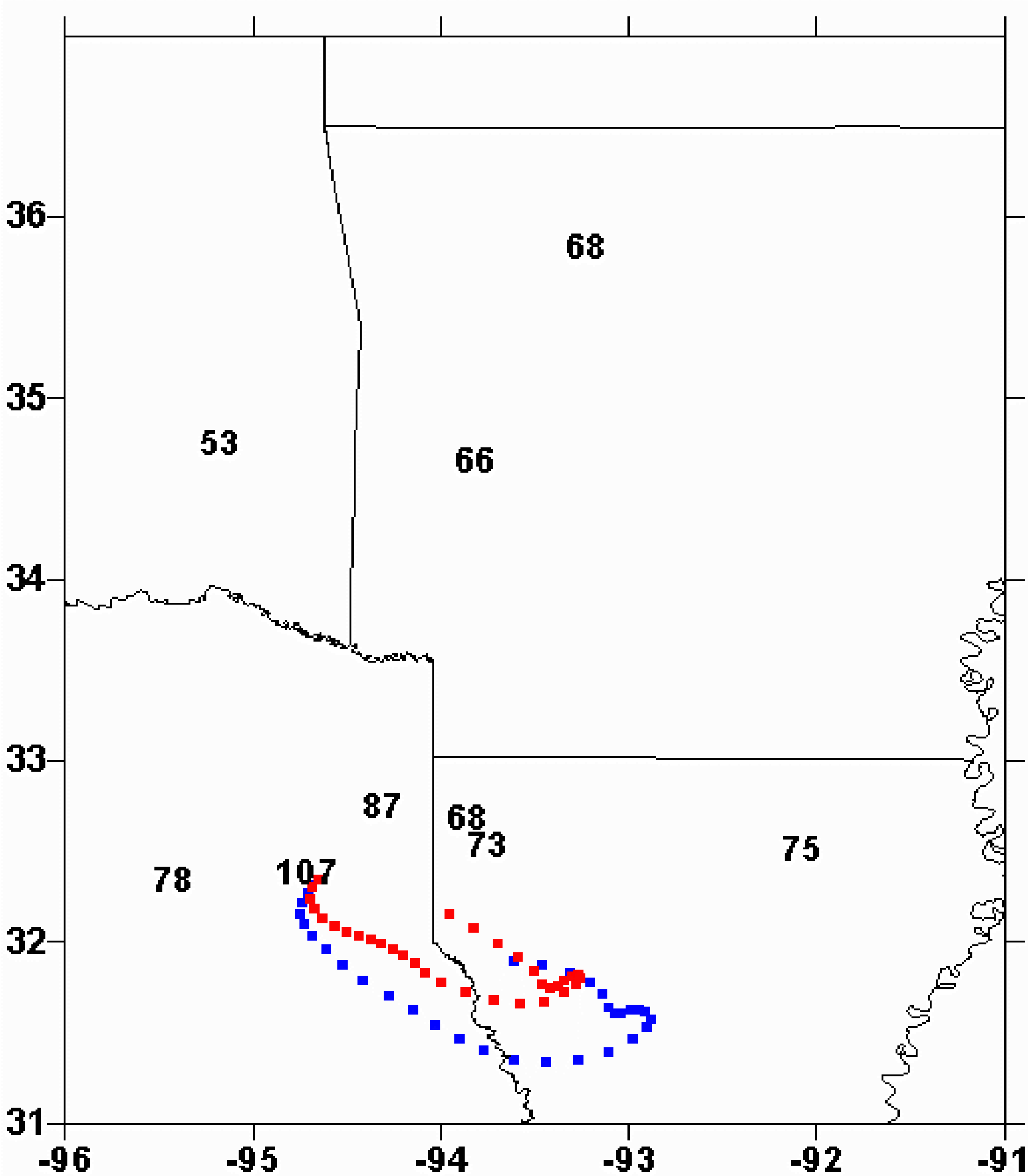
Texas Monitors:	Daily maximum 1-hr ozone on August 17th, 1999
Other Monitors:	Daily maximum 1-hr ozone on August 16th, 1999
Red Symbols:	Back trajectory at 1000 m from 15:00 on August 17th
Blue Symbols:	Back trajectory at 500 m from 15:00 on August 17th

Figure 2-2. Back trajectories for August 17th, 1999 with superimposed daily maximum 1-hour ozone for August 17th and 16th.



Texas Monitors: Daily maximum 1-hr ozone on August 20th, 1999
Other Monitors: Daily maximum 1-hr ozone on August 19th, 1999
Red Symbols: Back trajectory at 1000 m from 15:00 on August 20th
Blue Symbols: Back trajectory at 500 m from 15:00 on August 20th

Figure 2-3. Back trajectories for August 20th, 1999 with superimposed daily maximum 1-hour ozone for August 20th and 19th.



Texas Monitors:	Daily maximum 1-hr ozone on August 22nd, 1999
Other Monitors:	Daily maximum 1-hr ozone on August 21st, 1999
Red Symbols:	Back trajectory at 1000 m from 15:00 on August 22nd
Blue Symbols:	Back trajectory at 500 m from 15:00 on August 22nd

Figure 2-4. Back trajectories for August 22nd, 1999 with superimposed daily maximum 1-hour ozone for August 22nd and 21st.

3. EMISSIONS MODELING

This section describes the emission inventory preparation for the August 13-22, 1999 modeling episode for the East Texas Near Non-Attainment Area (NNA). Emission inventories are processed using version 2x of the Emissions Processing System (EPS2x) for area, off-road, onroad mobile and point sources. The purpose of the emissions processing is to format the emission inventory for CAMx photochemical modeling. Specifically, the emission inventory is allocated:

- Temporally – to account for seasonal, day of weak and hour of day variability
- Spatially – to reflect the geographic distributions of emissions
- Chemically – to account for the chemical composition of VOC and NOx emissions in terms of the Carbon Bond 4 (CB4) chemical mechanism used in CAMx.

Emissions for different major source groups (e.g., mobile, non-road mobile, area, point and biogenic) are processed separately and merged together prior to CAMx modeling. This simplifies the processing and assists quality assurance (QA) and reporting tasks. The biogenic inventories are generated with GloBEIS version 3.1.

The August 13-22,1999 episode, a Friday through Sunday, is being modeled in CAMx using a Lambert Conformal Projection (LCP) nested grid configuration with grid resolutions of 36, 12 and 4 km (Figure 1-1). In CAMx, emissions are separated between surface (surface and low level point) emissions and elevated point source emissions. For the surface emissions, a separate emission inventory is required for each grid nest, i.e., three inventories. For elevated point sources, a single emission inventory is prepared covering all grid nests.

Two emissions modeling domains are used to generate the required CAMx ready inventories:

1. **Near Non-Attainment Area 4 km Grid**. The NNA emissions grid has 54 x 45 cells at 4 km resolution and covers the same area as the CAMx 4 km nested grid shown in Figures 1-1 and 1-2.

2. **Regional Emissions Grid**. The regional emissions grid has 135 x 138 cells at 12-km resolution and covers the full area shown in Figure 1-1. This emissions grid is used for the 12 km CAMx grid by “windowing out” emissions for the appropriate region. In addition the regional emissions grid is aggregated from three by three 12-km cells to one 36-km cell over the entire area to generate the CAMx 36km grid.

Emission inventories were prepared for the 1999 base year and for 2002 and 2007 future years. The emissions data sources and processing are described separately below for point, onroad mobile, area, off-road, and biogenic sources. Following the data descriptions are summary tables.

DATA SOURCES FOR 1999

Point Sources

Point source data were obtained from several different sources, processed separately and merged prior to modeling. The data include:

- Texas electric generating units (EGUs)
- Texas non-EGU point sources
- Facility specific data
- Texas minor point sources
- Louisiana EGUs
- Louisiana non-EGUs
- Oklahoma EGUs
- Oklahoma non-EGUs
- Other State point sources

The point source data are processed for a typical peak ozone (PO) season weekday and weekend day. The exception is Texas, Louisiana and Oklahoma EGUs, which are hourly episode day specific data, based on continuous emissions monitor (CEM) data that were reported to EPA's "Acid Rain" database.

The 1999 Texas and Louisiana point source data were provided by TCEQ in EPS2 AFS input format. The TCEQ Point Source Data Base (PSDB) version 15a for 1999 is the basis of the non-EGU Texas data. Day specific data was provided for two stacks at the Eastman Chemical Company facility via email from J. Woolbert (NOXFOROZ-aug99.xls). The other emissions for Texas Eastman Chemical Company were provided by NETAC. Louisiana Department of Environmental Quality (LDEQ) provided TCEQ with a copy of their point source inventory which TCEQ converted into AFS format. The files that were downloaded from the TCEQ ftp site ftp://ftp.TCEQ.state.tx.us/pub/AirQuality/AirQualityPlanningAssessment/Modeling/ are:

TX EGU	DFWAQSE/Modeling/EI/Points/1999/hourly_TXegu_990813-990822.v15a.lcp.3pols
TX Non-EGU	DFWAQSE/Modeling/EI/Points/1999/afs.tx_negu.990813-990822.v15a.lcp.3pols
TX Minor Points	file-transfer/NearNon/afs.0813-2299minorpts_nna
LA EGU	file-transfer/NearNon/hourly_LAegu_0813-2299.afs_v4_latlon
LA Non-EGU	file-transfer/NearNon/afs.LA_0813-2299v4_latlon_negu

The Oklahoma EGU data were downloaded from the Acid Rain database. In addition, the 1999 NEI v2 Oklahoma data were reviewed and corrected by ODEQ before processing.

For all states other than Texas, Louisiana and Oklahoma the National Emission Inventory (NEI) 1999 Version 2 for Criteria Pollutants data is used. The Access database files *SS99CritPt1002.mdb* (where *SS* is the state abbreviation) were downloaded from EPA's ftp site. The data is processed to (1) relate separate data tables by common fields, (2) query to extract peak ozone season data for those states within the regional modeling domain and (3) export the resultant data table to an ASCII text file for processing through EPS2x.

The criteria for selecting NOx point sources for plume in grid treatment within the 4-km modeling domain is 2 tons NOx on any episode day. For the regional emissions grid, the NOx criteria is 25 tons per day on any episode day.

Mobile Sources

The Texas Transportation Institute (TTI) prepared mobile source emissions for all Texas counties under contract to the TCEQ. Emission factors are from the EPA's MOBILE6 model. Vehicle miles traveled (VMT) for 1999 are based on transportation models in all NNA counties that have a complete transportation model and were based on a rural HPMS method elsewhere. The NNA counties for which link based transportation model data are used:

East Texas:	Gregg, Smith
Austin:	Hays, Travis, Williamson
San Antonio:	Bexar
Corpus Christi:	Nueces, San Patricio
Victoria:	Victoria

TTI calculated emissions for each hour for four day-of-week scenarios: Monday-Thursday, Friday, Saturday and Sunday. The temperatures and humidities are for average August/September 1999 conditions in each county. The emissions are adjusted from the average scenario to day specific temperature and humidities in each county for modeling. The emissions reported here are for the average temperature/humidity scenario used by TTI.

Table 3-1. 1999 Texas onroad mobile source emissions (tons per day) from TTI for typical July/August 1999 conditions.

	Weekday			Friday			Saturday			Sunday		
County	**NOx**	**VOC**	**CO**	**NOx**	**VOC**	**CO**	**NOx**	**VOC**	**CO**	**NOx**	**VOC**	**CO**
Bexar	122	82	935	114	80	913	70	51	640	50	41	528
Gregg	26	6	78	25	8	97	18	7	88	13	6	86
Hays	11	5	70	10	5	75	7	4	59	5	3	53
Nueces	21	15	198	21	19	234	16	14	182	12	11	156
San Patricio	5	4	45	5	4	53	4	3	41	3	3	35
Smith	28	10	130	29	13	158	21	11	146	16	10	140
Travis	63	33	409	58	35	436	39	25	341	30	22	303
Victoria	9	4	51	10	5	69	7	4	56	6	5	61
Williamson	17	9	118	16	10	126	11	7	98	8	6	87
All Others	1103	669	8676	786	581	7404	548	433	5803	426	379	5135
Total	1404	836	10712	1074	759	9565	740	559	7453	570	487	6581

[1] Named counties have link-based data. All others have HPMS format activity data.

The emissions estimates prepared by TTI reflect a temperature/humidity profile for an average August/September day. To adjust for episodic conditions, a methodology was developed to calculate a temperature/humidity adjustment factor for each county. The steps in the process are as follows:

1. Run the MOBILE6 model using the county-level temperature/humidity profile used by TTI and extract the emission factors.

2. For each day in the modeling episode, run the MOBILE6 model using the county-level episodic conditions and extract the emission factors.

3. Calculate the ratio of episodic emission factor to base emission factor and apply this ratio to the emissions estimate generated by TTI.

The result of this processing was a mobile emissions inventory that accurately reflects the temperature and humidity in a given county during the modeling period. The link-based emissions are then speciated into CAMx chemical species and written to a CAMx emissions file using EPS2x. The inventory in counties with only county-wide VMT estimates required a gridding step, which was also implemented with EPS2x modules using gridded spatial surrogates.

County specific HPMS VMT and speed data for Oklahoma were provided by the Oklahoma Department of Transportation. Mobile6.2 emission factors were used to calculate county-level mobile emissions estimates for Oklahoma. The emissions estimates were processed through the EPS2x system to generate episode specific model-ready emissions estimates.

The NEI 1999 Version 2 for Criteria Pollutants, released by EPA October 2002, is the basis for the onroad mobile regional emissions inventory for those counties outside Texas and Oklahoma. The data file *99neiv2asciionroad.zip - 1999 NEI Version 2 Criteria Emissions from Onroad Mobile Sources in ASCII text format* was acquired from EPA's ftp site (ftp://ftp.epa.gov). The NEI 1999 onroad emission inventory is processed to (1) extract the typical peak ozone season day data, (2) reformatted to the EPS2x AMS input file format and (3) processed through EPS2x. A rural and urban road type spatial distribution is used to spatially allocate the urban and rural onroad sources.

Area Sources

Area emissions estimates for the counties within the East Texas NNA were based on the NETAC 1999 inventory. Refer to "Tyler/Longview/Marshall Flexible Attainment Region Emission Inventory Ozone Prescursors, VOC, NOx and CO 1999 Emissions" May 2002 for a detailed description of the inventory development. Jerry Demo of Pollution Solutions provided these data via email.

The TCEQ provided emission inventories for Texas area sources. The data were downloaded from the TCEQ domain at /pub/AirQuality/AirQualityPlanningAssessment/Modeling/file_transfer/TX99AreaNR. The file ams. TX_99.area_base1 are in EPS2x input file format.

For all areas outside Texas, the NEI 1999 Version 2 for Criteria Pollutants, released by EPA November 2002, is the basis for the area regional emissions inventory. The data file *99neiv2asciiarea.zip - 1999 NEI Version 2 Criteria Emissions from Area Sources in ASCII text format* was acquired from EPA's ftp site. The file format documentation is provided at http://www.epa.gov/ttn/chief/eidocs/index.html#pack. The NEI 1999 area emission inventory is (1) processed to extract the typical peak ozone season day data, (2) reformatted to the EPS2x

AMS input file format and (3) processed through EPS2x.

Off-Road Sources

Off-road source emissions were estimated with NonRoadv2002 using local survey data for mining and construction equipment for the counties within the East Texas NNA. The aircraft and railroad emissions were based on the NETAC 1999 inventory. Refer to "Tyler/Longview/Marshall Flexible Attainment Region Emission Inventory Ozone Prescursors, VOC, NOx and CO 1999 Emissions" May 2002 for a detailed description of the inventory development. Jerry Demo of Pollution Solutions provided these data via email.

The other Texas county off-road emissions were estimated with NonRoadv2002. The aircraft, commercial marine and railroad emissions were extracted from the TCEQ emission inventory for Texas off-road sources. The data were downloaded from the TCEQ domain at /pub/AirQuality/AirQualityPlanningAssessment/Modeling/file_transfer/TX99AreaNR. The files ams.TX_99.NR_base1 are in EPS2x input file format.

For all areas outside Texas the NEI 1999 Version 2 for Criteria Pollutants, released by EPA October 2002, is the basis for the off-road regional emissions inventory. The data file *99neiv2asciinonroad.zip - 1999 NEI Version 2 Criteria Emissions from Nonroad Sources in ASCII text format* was acquired from EPA's ftp site (ftp://ftp.epa.gov) and based on the NonRoadv2002 Model. The NEI 1999 off-road emission inventory is (1) processed to extract the typical peak ozone season day data, (2) reformatted to the EPS2x AMS input file format and (3) processed through EPS2x. The ODEQ provided corrections and updates for the state of Oklahoma NEI inventory.

Biogenic Sources

Biogenic emissions were prepared using version 3.1 of the GloBEIS model (Yarwood et al., 2002). The GloBEIS model was developed by the National Center for Atmospheric Research and ENVIRON under sponsorship from the TCEQ. GloBEIS3.1 is based on the EPA BEIS2 model with the following improvements:

- Updated emission factor algorithm (called the BEIS99 algorithm).
- Compatible with the EPA's BELD3 landuse/landcover (LULC) database.
- Compatible with the TCEQ's Texas specific LULC database (Yarwood et al., 2001) which includes local survey data for Northeast Texas developed by NETAC (ENVIRON, 1999).
- Ability to use solar radiation data for photosynthetically active radiation (PAR).
- Takes into account the effects of drought stress and prolonged periods of high temperature.

The preparation of biogenic emission inventories is described in detail at the end of Section 3.

EMISSIONS SUMMARIES FOR 1999

All emission estimates in the following tables reflect gridded, model ready emissions. This means that for partial counties and/or states at the edge of a modeling domain, only the portion of emissions that is within the modeling domain is reported.

Tables 3-2 to 3-4 are episode day emission summaries by major source type for the NNA counties and two Louisiana parishes.

Table 3-5 indicates episode day NOx emissions for the elevated point sources within the 4km grid which have been flagged for plume in grid treatment in CAMx modeling. Table 3-6 summarizes total NOx, elevated and surface, for Chemical Eastman. Figure 3-1 displays the average episode day NOx for these sources.

Table 3-7 represents total gridded Texas emissions for each episode day.

Tables 3-8 and 3-9 summarize the gridded emissions by major source type for states other than Texas.

Table 3-2. 1999 NOx for East Texas NNA and Shreveport area counties.

1999 NOx tons Episode Day	Source	Gregg 48183	Harrison 48203	Rusk 48401	Smith 48423	Upshur 48459	Bossier 22015	Caddo 22017
Friday, August 13	Area	12.6	7.9	13.1	5.5	8.4	3.9	43.7
	Off-road	4.7	6.3	2.8	6.8	2.4	4.2	7.9
	On-road	25.3	19.6	4.4	28.7	3.0	7.5	20.7
	Points	16.1	48.5	77.0	3.7	1.0	3.8	8.7
	Subtotal	58.7	82.4	97.2	44.7	14.8	19.4	81.0
	Biogenics	0.2	0.5	0.5	0.6	0.4	0.6	2.5
	Total	58.9	82.9	97.7	45.4	15.2	20.0	83.5
Saturday, August 14	Area	11.2	7.6	12.8	4.2	8.2	3.6	40.1
	Off-road	4.1	5.6	2.2	6.1	2.4	3.8	7.3
	On-road	17.8	14.5	3.5	20.6	2.2	5.6	15.5
	Points	9.9	47.8	80.8	3.5	1.0	3.8	7.3
	Subtotal	43.1	75.5	99.4	34.4	13.8	16.8	70.3
	Biogenics	0.2	0.5	0.5	0.6	0.4	0.6	2.3
	Total	43.2	75.9	99.8	35.1	14.2	17.4	72.6
Sunday, August 15	Area	9.8	7.2	12.5	3.0	8.1	3.4	38.4
	Off-road	3.5	4.8	1.5	5.2	2.3	3.3	6.5
	On-road	12.8	10.5	2.8	15.2	2.1	5.6	15.5
	Points	11.5	47.5	80.5	3.5	1.0	3.8	7.4
	Subtotal	37.6	69.9	97.4	27.0	13.4	16.2	67.7
	Biogenics	0.2	0.4	0.4	0.6	0.4	0.5	2.2
	Total	37.8	70.3	97.8	27.6	13.8	16.7	69.9
Monday, August 16	Area	12.6	7.9	13.1	5.5	8.4	3.9	43.7
	Off-road	4.7	6.3	2.8	6.8	2.4	4.2	7.9
	On-road	26.3	19.9	4.4	28.8	3.0	7.5	20.7
	Points	14.4	48.7	82.8	3.7	1.0	3.8	10.4
	Subtotal	58.0	82.9	103.0	44.8	14.7	19.4	82.8
	Biogenics	0.2	0.4	0.5	0.6	0.4	0.6	2.3
	Total	58.2	83.3	103.5	45.4	15.2	20.0	85.0
Tuesday, August 17	Area	12.6	7.9	13.1	5.5	8.4	3.9	43.7
	Off-road	4.7	6.3	2.8	6.8	2.4	4.2	7.9
	On-road	26.2	18.9	4.4	28.7	3.0	7.5	20.7
	Points	15.5	48.7	80.7	3.7	1.0	3.8	10.8
	Subtotal	59.0	81.9	100.9	44.7	14.8	19.4	83.1
	Biogenics	0.2	0.5	0.5	0.7	0.5	0.6	2.6
	Total	59.2	82.4	101.4	45.3	15.3	20.0	85.7
Wednesday, August 18	Area	12.6	7.9	13.1	5.5	8.4	3.9	43.7

1999 NOx tons Episode Day	Source	Gregg 48183	Harrison 48203	Rusk 48401	Smith 48423	Upshur 48459	Bossier 22015	Caddo 22017
	Off-road	4.7	6.3	2.8	6.8	2.4	4.2	7.9
	On-road	25.5	20.2	4.4	27.9	3.0	7.5	20.7
	Points	14.8	45.9	76.2	3.7	1.0	3.8	10.9
	Subtotal	57.5	80.4	96.5	43.9	14.8	19.4	83.2
	Biogenics	0.2	0.5	0.5	0.7	0.5	0.7	2.7
	Total	57.7	80.9	97.0	44.6	15.3	20.1	85.9
Thursday, August 19	Area	12.6	7.9	13.1	5.5	8.4	3.9	43.7
	Off-road	4.7	6.3	2.8	6.8	2.4	4.2	7.9
	On-road	25.6	20.2	4.4	28.0	2.9	7.5	20.7
	Points	16.1	49.9	77.2	3.7	1.0	3.8	11.2
	Subtotal	59.0	84.3	97.4	44.0	14.7	19.4	83.5
	Biogenics	0.2	0.6	0.6	0.8	0.5	0.7	3.0
	Total	59.2	84.9	98.0	44.7	15.2	20.1	86.5
Friday, August 20	Area	12.6	7.9	13.1	5.5	8.4	3.9	43.7
	Off-road	4.7	6.3	2.8	6.8	2.4	4.2	7.9
	On-road	25.1	20.1	4.4	28.5	3.1	7.5	20.7
	Points	17.6	45.6	81.8	3.7	1.0	3.8	11.8
	Subtotal	60.0	80.0	102.1	44.5	14.8	19.4	84.1
	Biogenics	0.2	0.5	0.5	0.6	0.4	0.6	2.5
	Total	60.2	80.4	102.6	45.2	15.3	20.0	86.6
Saturday, August 21	Area	11.2	7.6	12.8	4.2	8.2	3.6	40.1
	Off-road	4.1	5.6	2.2	6.1	2.4	3.8	7.3
	On-road	18.3	14.6	3.6	21.1	2.4	5.6	15.5
	Points	16.2	22.1	80.6	3.5	1.0	3.8	12.0
	Subtotal	49.9	49.9	99.3	35.0	14.0	16.8	75.0
	Biogenics	0.2	0.5	0.5	0.6	0.4	0.6	2.4
	Total	50.1	50.4	99.8	35.7	14.4	17.4	77.4
Sunday, August 22	Area	9.8	7.2	12.5	3.0	8.1	3.4	38.4
	Off-road	3.5	4.8	1.5	5.2	2.3	3.3	6.5
	On-road	13.5	10.2	2.9	16.1	2.0	5.6	15.5
	Points	12.6	38.9	84.1	3.5	1.0	3.8	9.6
	Subtotal	39.4	61.0	101.1	27.8	13.3	16.2	70.0
	Biogenics	0.2	0.5	0.5	0.7	0.4	0.6	2.5
	Total	39.6	61.5	101.6	28.5	13.8	16.8	72.5
Average Episode Day	Area	12.0	7.8	12.9	5.0	8.3	3.8	42.4
	Off-road	4.4	6.0	2.5	6.5	2.4	4.0	7.6
	On-road	22.9	17.7	4.1	25.5	2.7	6.9	19.2
	Points	14.7	45.5	79.9	3.6	1.0	3.8	10.2
	Subtotal	54.0	77.0	99.4	40.6	14.4	18.6	79.5
	Biogenics	0.2	0.5	0.5	0.7	0.4	0.6	2.5
	Total	54.2	77.5	99.9	41.3	14.9	19.2	82.1

Table 3-3. 1999 VOC for East Texas NNA and Shreveport area counties.

1999 VOC tons Episode Day	Source	Gregg 48183	Harrison 48203	Rusk 48401	Smith 48423	Upshur 48459	Bossier 22015	Caddo 22017
Friday, August 13	Area	14.8	13.4	11.9	14.6	13.5	6.2	26.4
	Off-road	2.4	1.2	0.8	3.8	0.4	1.7	4.5
	On-road	6.7	6.4	3.7	10.9	2.3	5.4	16.1
	Points	3.5	15.6	2.0	8.9	0.8	1.6	5.8
	Subtotal	27.4	36.6	18.5	38.2	17.0	14.9	52.7
	Biogenics	64.2	325.9	280.4	254.5	154.0	298.7	238.5
	Total	91.6	362.5	298.9	292.6	170.9	313.5	291.3
Saturday, August 14	Area	11.5	11.3	10.1	10.1	12.5	6.2	26.3
	Off-road	2.9	2.2	1.7	5.4	0.7	2.6	7.4
	On-road	6.4	5.1	3.2	10.5	2.9	4.1	12.1
	Points	3.1	14.6	2.0	7.7	0.8	1.6	5.8
	Subtotal	23.9	33.3	16.9	33.6	16.9	14.5	51.6
	Biogenics	61.2	297.1	263.2	234.8	148.9	259.0	205.0
	Total	85.1	330.4	280.1	268.4	165.7	273.5	256.6
Sunday, August 15	Area	10.0	10.4	9.3	7.7	11.9	6.2	26.3
	Off-road	2.8	2.1	1.6	5.2	0.7	2.5	7.2
	On-road	6.8	5.3	4.3	11.0	2.1	4.1	12.1
	Points	3.1	14.6	2.0	7.7	0.8	1.6	5.8
	Subtotal	22.6	32.4	17.1	31.6	15.5	14.4	51.4
	Biogenics	54.5	257.5	231.2	218.1	132.0	218.3	176.4
	Total	77.1	289.9	248.4	249.7	147.5	232.7	227.8
Monday, August 16	Area	14.8	13.4	11.9	14.6	13.5	6.2	26.4
	Off-road	2.4	1.2	0.8	3.8	0.4	1.7	4.5
	On-road	5.8	5.2	3.1	9.5	2.0	5.4	16.1
	Points	3.5	15.6	2.0	8.9	0.8	1.6	5.8
	Subtotal	26.5	35.3	17.9	36.8	16.7	14.9	52.7
	Biogenics	57.9	276.2	240.2	228.2	140.2	236.6	185.4
	Total	84.4	311.5	258.1	265.0	156.9	251.5	238.2
Tuesday, August 17	Area	14.8	13.4	11.9	14.6	13.5	6.2	26.4
	Off-road	2.4	1.2	0.8	3.8	0.4	1.7	4.5
	On-road	6.3	7.2	3.1	10.2	2.0	5.4	16.1
	Points	3.5	15.6	2.0	8.9	0.8	1.6	5.8
	Subtotal	27.0	37.3	17.8	37.5	16.7	14.9	52.7
	Biogenics	64.8	322.8	264.4	250.1	160.9	285.1	225.4
	Total	91.8	360.1	282.2	287.6	177.6	299.9	278.1
Wednesday, August 18	Area	14.8	13.4	11.9	14.6	13.5	6.2	26.4
	Off-road	2.4	1.2	0.8	3.8	0.4	1.7	4.5
	On-road	6.4	4.7	3.0	10.4	2.0	5.4	16.1
	Points	3.5	15.6	2.0	8.9	0.8	1.6	5.8
	Subtotal	27.1	34.9	17.7	37.7	16.7	14.9	52.7
	Biogenics	70.0	343.6	292.5	273.6	168.8	312.2	242.7
	Total	97.1	378.5	310.3	311.2	185.4	327.0	295.5
Thursday, August 19	Area	14.8	13.4	11.9	14.6	13.5	6.2	26.4
	Off-road	2.4	1.2	0.8	3.8	0.4	1.7	4.5
	On-road	6.3	4.7	3.0	10.3	1.8	5.4	16.1
	Points	3.5	15.6	2.0	8.9	0.8	1.6	5.8
	Subtotal	27.0	34.8	17.8	37.5	16.5	14.9	52.7
	Biogenics	76.7	377.5	316.4	299.0	184.4	339.1	267.8
	Total	103.7	412.3	334.2	336.5	200.9	354.0	320.5
Friday, August 20	Area	14.8	13.4	11.9	14.6	13.5	6.2	26.4
	Off-road	2.4	1.2	0.8	3.8	0.4	1.7	4.5
	On-road	7.7	5.8	3.4	12.6	2.4	5.4	16.1
	Points	3.5	15.6	2.0	8.9	0.8	1.6	5.8

1999 VOC tons Episode Day	Source	Gregg 48183	Harrison 48203	Rusk 48401	Smith 48423	Upshur 48459	Bossier 22015	Caddo 22017
	Subtotal	28.4	36.0	18.1	39.8	17.1	14.9	52.7
	Biogenics	65.4	313.7	281.7	254.1	152.4	274.5	220.0
	Total	93.8	349.6	299.8	293.9	169.5	289.3	272.7
Saturday, August 21	Area	11.5	11.3	10.1	10.1	12.5	6.2	26.3
	Off-road	2.9	2.2	1.7	5.4	0.7	2.6	7.4
	On-road	6.7	5.0	3.1	10.9	1.9	4.1	12.1
	Points	3.1	14.6	2.0	7.7	0.8	1.6	5.8
	Subtotal	24.2	33.2	16.8	34.1	15.9	14.5	51.6
	Biogenics	61.8	292.0	258.1	242.2	148.3	253.4	202.4
	Total	86.0	325.1	274.9	276.3	164.2	267.9	254.0
Sunday, August 22	Area	10.0	10.4	9.3	7.7	11.9	6.2	26.3
	Off-road	2.8	2.1	1.6	5.2	0.7	2.5	7.2
	On-road	6.4	5.4	2.9	10.3	1.8	4.1	12.1
	Points	3.1	14.6	2.0	7.7	0.8	1.6	5.8
	Subtotal	22.2	32.5	15.7	31.0	15.2	14.4	51.4
	Biogenics	64.2	308.5	263.8	249.2	155.1	263.5	210.7
	Total	86.4	341.0	279.5	280.1	170.2	277.9	262.1
Average Episode Day	Area	13.6	12.7	11.3	13.0	13.1	6.2	26.4
	Off-road	2.5	1.5	1.1	4.2	0.5	1.9	5.3
	On-road	6.5	5.5	3.2	10.5	2.1	5.0	14.9
	Points	3.4	15.3	2.0	8.5	0.8	1.6	5.8
	Subtotal	26.0	34.9	17.5	36.2	16.5	14.7	52.4
	Biogenics	65.0	316.8	271.8	253.9	157.1	279.5	221.1
	Total	91.0	351.7	289.4	290.1	173.5	294.3	273.5

Table 3-4. 1999 CO for East Texas NNA and Shreveport area counties.

1999 CO tons Episode Day	Source	Gregg 48183	Harrison 48203	Rusk 48401	Smith 48423	Upshur 48459	Bossier 22015	Caddo 22017
Friday, August 13	Area	3.6	7.0	8.2	8.4	5.5	7.3	13.6
	Off-road	39.4	10.1	7.8	51.1	4.9	21.9	57.5
	On-road	88.4	85.6	45.3	144.3	28.6	55.9	164.3
	Points	5.8	12.7	6.1	2.1	0.7	1.4	2.7
	Subtotal	137.2	115.5	67.5	205.9	39.7	86.6	238.1
	Biogenics	5.6	29.9	27.1	22.8	14.6	26.6	21.1
	Total	142.8	145.4	94.6	228.7	54.4	113.2	259.2
Saturday, August 14	Area	3.1	6.4	7.7	6.7	4.9	7.3	13.1
	Off-road	56.2	15.7	11.9	69.8	6.3	28.8	85.4
	On-road	87.3	73.3	40.2	143.9	35.7	41.9	123.2
	Points	5.5	12.7	6.1	2.0	0.7	1.4	2.7
	Subtotal	152.2	108.2	65.8	222.4	47.7	79.5	224.4
	Biogenics	5.6	28.8	27.0	22.4	14.7	23.9	19.3
	Total	157.8	137.0	92.8	244.7	62.4	103.4	243.7
Sunday, August 15	Area	2.7	5.8	7.1	5.1	4.4	7.3	12.8
	Off-road	54.9	15.0	11.4	68.3	6.1	28.1	83.6
	On-road	92.1	75.6	52.2	150.1	27.2	41.9	123.2
	Points	5.5	12.7	6.1	2.0	0.7	1.4	2.7
	Subtotal	155.2	109.2	76.7	225.5	38.5	78.7	222.3
	Biogenics	5.0	25.1	23.7	20.5	13.0	20.6	16.8
	Total	160.2	134.2	100.4	246.0	51.5	99.3	239.1
Monday, August 16	Area	3.6	7.0	8.2	8.4	5.5	7.3	13.6
	Off-road	39.4	10.1	7.8	51.1	4.9	21.9	57.5
	On-road	73.2	69.2	37.3	121.5	24.3	55.9	164.3
	Points	5.8	12.7	6.1	2.1	0.7	1.4	2.7
	Subtotal	122.0	99.2	59.4	183.1	35.5	86.6	238.1
	Biogenics	5.4	27.2	24.8	21.8	13.9	22.5	18.1
	Total	127.4	126.4	84.2	205.0	49.3	109.0	256.2
Tuesday, August 17	Area	3.6	7.0	8.2	8.4	5.5	7.3	13.6
	Off-road	39.4	10.1	7.8	51.1	4.9	21.9	57.5
	On-road	76.7	77.2	37.0	127.4	24.0	55.9	164.3
	Points	5.8	12.7	6.1	2.1	0.7	1.4	2.7
	Subtotal	125.5	107.1	59.2	189.0	35.1	86.6	238.1
	Biogenics	6.1	31.6	27.3	24.3	16.1	26.5	21.5
	Total	131.6	138.7	86.5	213.3	51.2	113.1	259.6
Wednesday, August 18	Area	3.6	7.0	8.2	8.4	5.5	7.3	13.6
	Off-road	39.4	10.1	7.8	51.1	4.9	21.9	57.5
	On-road	78.6	93.2	37.0	130.5	24.4	55.9	164.3
	Points	5.8	12.7	6.1	2.1	0.7	1.4	2.7
	Subtotal	127.4	123.1	59.2	192.1	35.5	86.6	238.1
	Biogenics	6.6	33.9	30.4	26.5	17.1	29.3	23.1
	Total	134.0	157.0	89.6	218.7	52.6	115.8	261.2
Thursday, August 19	Area	3.6	7.0	8.2	8.4	5.5	7.3	13.6
	Off-road	39.4	10.1	7.8	51.1	4.9	21.9	57.5
	On-road	78.4	64.7	36.7	130.3	24.2	55.9	164.3
	Points	5.8	12.7	6.1	2.1	0.7	1.4	2.7
	Subtotal	127.3	94.6	58.8	191.9	35.3	86.6	238.1
	Biogenics	7.2	37.6	32.7	28.5	18.6	32.5	25.9
	Total	134.5	132.2	91.6	220.4	53.9	119.1	264.0
Friday, August 20	Area	3.6	7.0	8.2	8.4	5.5	7.3	13.6
	Off-road	39.4	10.1	7.8	51.1	4.9	21.9	57.5
	On-road	96.8	64.4	36.6	158.1	23.3	55.9	164.3
	Points	5.8	12.7	6.1	2.1	0.7	1.4	2.7

1999 CO tons Episode Day	Source	Gregg 48183	Harrison 48203	Rusk 48401	Smith 48423	Upshur 48459	Bossier 22015	Caddo 22017
	Subtotal	145.7	94.3	58.8	219.7	34.4	86.6	238.1
	Biogenics	5.9	30.3	28.5	23.7	14.8	25.8	20.8
	Total	151.6	124.6	87.3	243.4	49.2	112.3	258.9
Saturday, August 21	Area	3.1	6.4	7.7	6.7	4.9	7.3	13.1
	Off-road	56.2	15.7	11.9	69.8	6.3	28.8	85.4
	On-road	88.3	80.0	42.1	145.5	29.1	41.9	123.2
	Points	5.5	12.7	6.1	2.0	0.7	1.4	2.7
	Subtotal	153.1	114.9	67.7	224.0	41.0	79.5	224.4
	Biogenics	5.6	28.2	26.4	22.8	14.5	23.5	19.0
	Total	158.8	143.1	94.2	246.8	55.6	103.0	243.4
Sunday, August 22	Area	2.7	5.8	7.1	5.1	4.4	7.3	12.8
	Off-road	54.9	15.0	11.4	68.3	6.1	28.1	83.6
	On-road	85.6	72.5	38.6	139.5	25.1	41.9	123.2
	Points	5.5	12.7	6.1	2.0	0.7	1.4	2.7
	Subtotal	148.7	106.0	63.1	214.9	36.4	78.7	222.3
	Biogenics	6.0	30.2	27.6	24.3	15.5	24.8	20.2
	Total	154.7	136.2	90.7	239.2	51.9	103.5	242.6
Average Episode Day	Area	3.4	6.8	8.0	7.7	5.2	7.3	13.4
	Off-road	44.0	11.6	8.9	56.2	5.3	23.7	65.2
	On-road	82.3	75.7	39.4	135.8	25.9	51.9	152.6
	Points	5.7	12.7	6.1	2.1	0.7	1.4	2.7
	Subtotal	135.5	106.9	62.4	201.8	37.2	84.4	233.9
	Biogenics	6.0	30.9	27.9	24.2	15.6	26.2	21.0
	Total	141.5	137.8	90.3	226.0	52.8	110.6	254.9

Table 3-5. 1999 tons/day NOx for facilities treated with plume in grid within the 4km domain. These represent only the elevated point emissions at each facility.

Facility Name	Stack	Aug 13	Aug 14	Aug 15	Aug 16	Aug 17	Aug 18	Aug 19	Aug 20	Aug 21	Aug 22	Episode Average
Arsenal	1	1.6	0.9	0.9	1.8	1.8	2.0	2.0	2.4	2.2	1.4	1.7
Arsenal Total		1.6	0.9	0.9	1.8	1.8	2.0	2.0	2.4	2.2	1.4	1.7
Dolet_Hills_Power	1	36.8	38.6	36.8	38.9	40.5	39.6	38.1	36.8	36.9	38.6	38.5
Dolet_Hills_Power Total		36.8	38.6	36.8	38.9	40.5	39.6	38.1	36.8	36.9	38.6	38.5
Eastman_Chemical_Co	148	0.0	0.0	0.0	0.0	0.0	0.8	2.4	2.3	2.3	2.1	0.9
	149	2.4	2.3	2.3	2.4	2.4	2.0	2.0	1.9	2.2	1.9	2.2
Eastman_Chemical_Co Total		2.4	2.3	2.3	2.4	2.4	2.8	4.4	4.2	4.5	4	3.1
Knox_Lee	3	0.3	0.2	0.3	0.3	0.3	0.3	0.4	0.5	0.3	0.3	0.3
	4	1.4	0.3	0.8	1.2	1.2	0.4	0.8	0.7	1.5	0.8	0.9
	5	3.3	1	1.9	2.1	3.2	3.3	3.7	5	3.6	2.3	3.0
	6	5.1	2.8	3	4.9	4.9	4.8	5.2	5.5	5.2	3.7	4.6
Knox_Lee Total		10.1	4.3	6	8.5	9.6	8.8	10.1	11.7	10.6	7.1	8.8
Lieberman	3	1.9	1.2	1.3	2.3	2.4	2.4	2.6	2.6	3.2	1.9	2.3
	4	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
Lieberman Total		3.0	2.3	2.5	3.5	3.6	3.6	3.8	3.8	4.3	3.0	3.4
Martin_Lake	5	27.1	27.2	27.9	29.6	27.2	26.6	27.2	28.5	28.5	30.4	27.9
	6	24.4	24.9	23.2	23.7	23.2	23.3	24	25.5	25	26.3	24.1
	7	24.1	27.3	27.9	28.2	28.9	24.9	24.6	26.5	25.7	26	26.5
Martin_Lake Total		75.6	79.4	79	81.5	79.3	74.8	75.8	80.5	79.2	82.7	78.5
Monticello	7	20.7	20.6	20.4	21.6	20.7	22.1	21.5	22.9	21.9	21.7	21.4
	9	20.4	20.1	20.2	20	19.1	20.2	20.3	20	20	20	20.0
	10	20.8	21.1	21.1	21.4	21.6	22.3	22.9	21.8	21.3	22	21.8
Monticello Total		61.9	61.8	61.7	63	61.4	64.6	64.7	64.7	63.2	63.7	63.2
Pirkey	1	28.5	27.8	27.5	28.6	28.6	25.4	27.9	23.7	0.0	17.2	24.7
Pirkey Total		28.5	27.8	27.5	28.6	28.6	25.4	27.9	23.7	0.0	17.2	24.7
Stryker_Creek	1	3.7	4.1	3.8	4.3	4.1	3.9	4.4	3.4	3.6	2.5	3.9

Facility Name	Stack	Aug 13	Aug 14	Aug 15	Aug 16	Aug 17	Aug 18	Aug 19	Aug 20	Aug 21	Aug 22	Episode Average
	2	3.7	4.1	3.8	4.3	4.1	3.9	4.4	3.4	3.6	2.5	3.9
	3	3	3	3	3.2	3.2	3.3	3.5	2.9	2.8	2.9	3.1
	4	3	3	3	3.2	3.2	3.3	3.5	2.9	2.8	2.9	3.1
Stryker_Creek Total		13.4	14.2	13.6	15	14.6	14.4	15.8	12.6	12.8	10.8	14.1
Welsh	11	35.6	33.3	34.8	34.6	36.1	35.1	34.9	33	32.8	30.9	34.4
	12	28	26	25.6	27.4	26.2	26	27.3	26.2	27.4	24.4	26.5
	13	27	24.9	19.6	0	0	0	0	0	0.2	18.7	6.5
Welsh Total		90.6	84.2	80	62	62.3	61.1	62.2	59.2	60.4	74	67.4
Wilkes	1	6.1	4.3	4	7.1	5.6	7.5	7.2	8	8.1	5.8	6.5
	2	5.5	3.9	4.6	5.1	5.4	7.4	7	6.6	8.7	5.2	6.0
	3	1.8	1.1	1.1	1.9	2	2.1	2.2	2.3	2.5	1.7	1.9
Wilkes Total		13.4	9.3	9.7	14.1	13	17	16.4	16.9	19.3	12.7	14.5

Note: The August 1999 episode consists of the dates Aug. 13-22. Weekday dates correspond to Aug. 13 and Aug. 16-20. Weekend dates are Aug. 14-15 and Aug. 21-22.

Table 3-6. Eastman Chemical Co. average August 1999 episode day (tons per day). The 'other' represents almost four hundred generating stacks.

	Stack 148	Stack 149	Other Elevated	Other Surface	Total
NOx	1.0	2.2	9.3	1.9	14.4
VOC	0.016	0.016	1.0	9.6	10.7

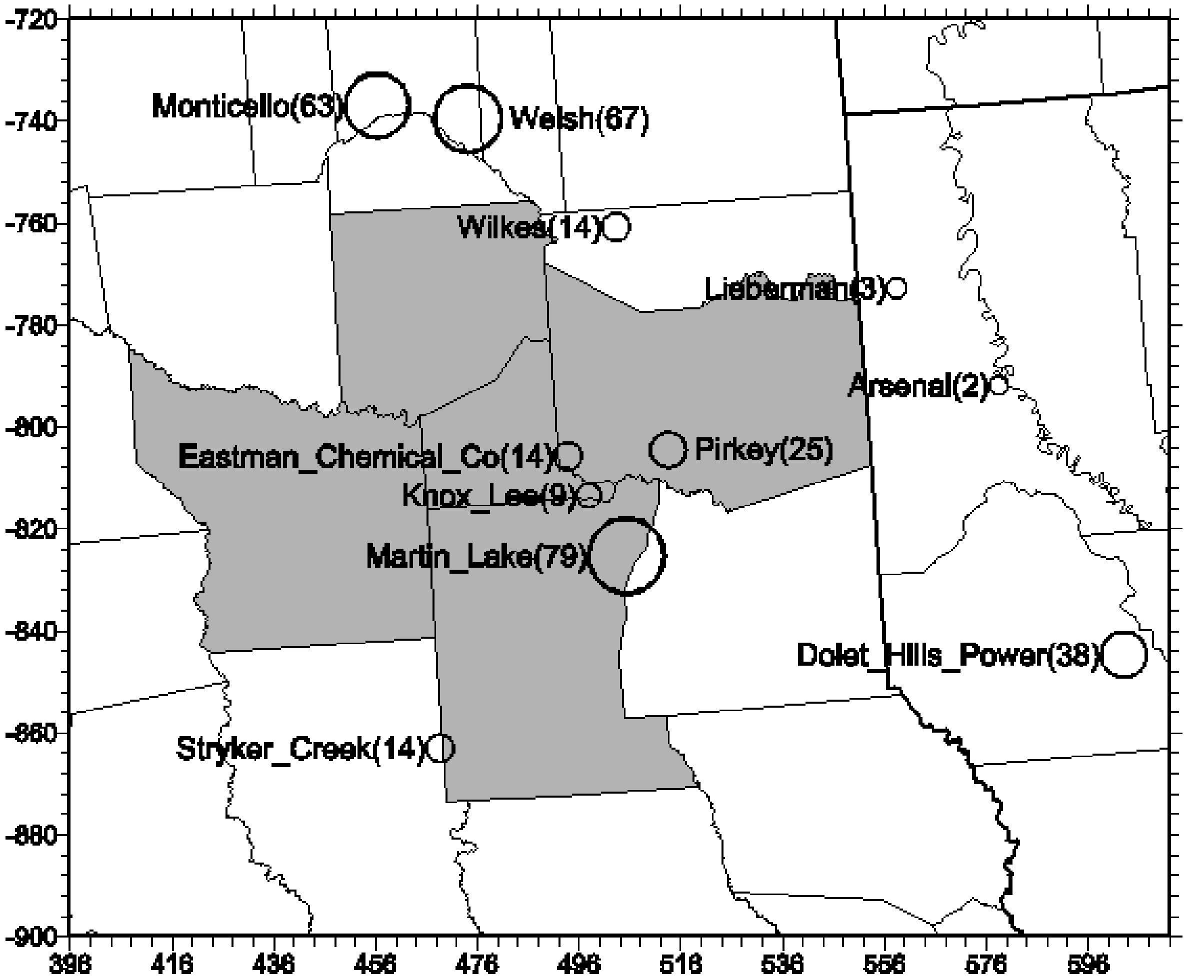


Figure 3-1. 1999 average episode day NOx for the facilities in Table 3-5. These represent elevated sources for all facilities with the exception of Eastman Chemical which represents the total NOx from Table 3-6.

Table 3-7. Texas gridded 1999 episode day emissions by major source type.

Episode Day	Area	Off-road	On-road	EGUs	Other Points	Off Shore	Ship-ping	Total Anthropc genic	Bio-genic	Total
Tons NOx										
Friday, August 13	636	980	1396	1472	999	549	35	6066	1100	7166
Saturday, August 14	619	949	971	1403	998	549	35	5524	1082	6606
Sunday, August 15	602	877	747	1336	998	549	35	5144	1105	6249
Monday, August 16	636	980	1441	1392	999	549	35	6032	1082	7114
Tuesday, August 17	636	980	1425	1367	999	549	35	5990	1040	7030
Wednesday, August 18	636	980	1422	1430	999	549	35	6051	1078	7129
Thursday, August 19	636	980	1446	1457	1001	549	35	6103	1068	7171
Friday, August 20	636	980	1429	1400	1001	549	35	6030	1052	7082
Saturday, August 21	619	949	981	1304	1000	549	35	5436	1053	6489
Sunday, August 22	602	877	735	1280	1000	549	35	5077	1010	6087
Tons VOC										
Friday, August 13	1736	462	1057	20	538	189	1	4003	22087	26090
Saturday, August 14	1395	850	797	19	509	189	1	3760	20527	24287
Sunday, August 15	1197	836	674	20	509	189	1	3425	20445	23871
Monday, August 16	1736	462	915	20	538	189	1	3861	19998	23859
Tuesday, August 17	1736	462	904	20	538	189	1	3850	19290	23141
Wednesday, August 18	1736	462	914	19	538	189	1	3859	20752	24611
Thursday, August 19	1736	462	940	19	538	189	1	3886	21745	25631
Friday, August 20	1736	462	1086	19	538	189	1	4032	20788	24819
Saturday, August 21	1395	850	785	19	509	189	1	3747	19565	23312
Sunday, August 22	1197	836	651	19	509	189	1	3402	18023	21426
Tons CO										
Friday, August 13	958	5388	13259	230	825	126	5	20791	2270	23061
Saturday, August 14	823	7770	10437	228	821	126	5	20210	2159	22368
Sunday, August 15	690	7631	8948	230	821	126	5	18450	2128	20578
Monday, August 16	958	5388	11384	228	825	126	5	18915	2078	20993
Tuesday, August 17	958	5388	11347	228	825	126	5	18878	2005	20883
Wednesday, August 18	958	5388	11546	218	825	126	5	19066	2136	21202
Thursday, August 19	958	5388	11679	218	825	126	5	19199	2212	21412
Friday, August 20	958	5388	13215	226	825	126	5	20744	2127	22871
Saturday, August 21	823	7770	10202	222	821	126	5	19969	2045	22013
Sunday, August 22	690	7631	8855	227	821	126	5	18354	1963	20317

Table 3-8. Summary of 1999 gridded emissions by major source type for states other than Texas.

	Area			Off-road			On-road			Points			Anthropogenic		
State	Week day	Sat	Sun	Week Day	Sat	Sun	Week Day	Sat	Sun	Week Day	Sat	Sun	Total weekday	Total Sat	Total Sun
NOx															
Alabama	35	34	34	518	514	498	458	343	343	848	834	834	1858	1725	1708
Arkansas	116	107	102	209	204	193	282	212	212	317	316	316	924	839	823
Florida	7	7	6	35	39	35	116	87	87	206	206	206	365	339	335
Georgia	72	68	66	192	173	150	637	478	478	514	509	509	1415	1228	1203
Illinois	13	12	12	257	253	245	220	165	165	510	605	605	1000	1035	1028
Indiana	33	30	29	153	144	133	240	180	180	802	810	810	1227	1164	1152
Kansas	33	31	30	314	302	288	252	189	189	469	434	434	1068	956	940
Kentucky	246	227	217	273	267	254	448	336	336	1032	1024	1024	1999	1854	1830
Louisiana2	327	301	288	685	683	665	386	290	290	1171	1171	1121	2569	2445	2364
Mississippi	6	6	6	220	217	206	354	266	266	529	529	529	1110	1018	1007
Missouri	177	165	159	447	444	422	592	444	444	684	686	686	1900	1740	1711
Nebraska	4	4	3	60	60	59	18	14	14	27	10	10	109	86	86
North Carolina	1	1	1	3	2	2	21	16	16	13	13	13	38	32	31
Ohio	24	22	21	99	92	84	131	98	98	653	651	651	907	863	854
Oklahoma1,2	71	66	63	328	325	314	397	400	397	670	592	592	1467	1383	1366
South Carolina	0	0	0	0	0	0	3	2	2	0	0	0	4	3	3

	Area			Off-road			On-road			Points			Anthropogenic		
State	Week day	Sat	Sun	Week Day	Sat	Sun	Week Day	Sat	Sun	Week Day	Sat	Sun	Total weekday	Total Sat	Total Sun
Tennessee	63	59	57	275	264	242	556	417	417	765	785	785	1657	1525	1502
Virginia	1	1	1	4	4	4	9	7	7	2	0	0	17	12	12
West Virginia	3	3	3	37	37	35	15	12	12	121	121	121	177	172	171
Grand Total	1233	1143	1099	4112	4024	3828	5136	3954	3952	9331	9297	9247	19812	18419	18126
VOC															
Alabama	491	491	491	140	345	342	345	259	259	207	166	166	1183	1260	1257
Arkansas	381	381	381	82	201	199	185	139	139	97	84	84	745	804	802
Florida	127	127	127	52	189	188	85	64	64	117	114	114	381	493	493
Georgia	421	421	421	136	212	208	417	313	313	70	51	51	1044	997	993
Illinois	208	208	208	63	114	113	136	102	102	87	69	69	494	493	492
Indiana	279	279	279	54	95	93	160	120	120	82	53	53	575	546	544
Kansas	318	317	317	84	128	126	173	129	129	85	52	52	659	626	624
Kentucky	410	409	409	93	225	223	293	220	220	208	149	149	1004	1003	1001
Louisiana2	420	419	419	150	421	418	246	184	184	258	273	272	1074	1297	1294
Mississippi	427	427	427	80	219	218	207	155	155	168	165	165	882	967	966
Missouri	922	921	921	205	491	487	387	290	290	125	95	95	1640	1798	1793
Nebraska	44	44	44	9	13	13	11	8	8	3	3	3	68	69	69
North Carolina	17	17	17	5	10	10	12	9	9	7	5	5	41	41	41
Ohio	152	152	152	50	58	57	97	72	72	17	13	13	315	296	294
Oklahoma1,2	311	310	310	97	219	217	416	402	414	106	97	97	929	1029	1039
South Carolina	2	2	2	1	1	1	2	1	1	0	0	0	4	5	5
Tennessee	709	709	708	134	316	312	369	277	277	297	164	164	1509	1465	1461
Virginia	8	8	8	1	1	1	6	4	4	2	0	0	16	13	13
West Virginia	23	23	23	6	12	12	11	8	8	9	8	8	49	52	52
Grand Total	5669	5667	5666	1438	3271	3239	3557	2758	2770	1948	1559	1559	12612	13255	13233
CO															
Alabama	245	245	245	1195	1964	1929	3592	2694	2694	479	436	436	5512	5339	5304
Arkansas	121	120	119	702	1154	1128	2027	1520	1520	297	293	293	3147	3087	3061
Florida	60	60	60	358	744	736	859	644	644	601	600	600	1878	2049	2040
Georgia	502	501	500	1851	2574	2524	4641	3481	3481	192	180	180	7186	6736	6684
Illinois	38	38	37	680	929	912	1475	1107	1107	104	104	104	2297	2177	2160
Indiana	93	92	92	685	903	879	1667	1250	1250	181	154	154	2626	2400	2375
Kansas	87	84	83	1017	1346	1317	1870	1403	1403	248	235	235	3222	3068	3037
Kentucky	200	197	195	897	1442	1413	3075	2306	2306	295	285	285	4467	4230	4199
Louisiana2	182	178	177	1181	2097	2064	2742	2056	2056	855	873	871	4960	5204	5168
Mississippi	125	125	125	647	1126	1103	2092	1569	1569	194	193	193	3058	3012	2989
Missouri	372	369	368	2087	3231	3180	4002	3002	3002	311	306	306	6773	6908	6855
Nebraska	3	3	3	94	126	124	122	91	91	4	3	3	223	223	221
North Carolina	17	17	17	44	62	61	134	100	100	9	9	9	204	188	187
Ohio	63	63	63	755	901	883	980	735	735	96	91	91	1894	1791	1773
Oklahoma1,2	84	83	83	964	1488	1466	2846	2810	2848	192	186	186	4086	4568	4583
South Carolina	3	3	3	4	7	7	20	15	15	0	0	0	28	25	25
Tennessee	267	265	265	1374	2161	2112	3904	2928	2928	267	272	272	5812	5626	5577
Virginia	5	5	5	11	14	14	61	45	45	1	1	1	78	65	65
West Virginia	12	12	12	49	77	74	114	86	86	14	13	13	188	187	185
Grand Total	2480	2461	2451	14596	22345	21925	36222	27843	27880	4338	4234	4233	57637	56883	56489

[1] For Oklahoma, On-road Weekday is Aug. 17, Saturday is Aug. 14, Sunday is Aug. 15

[2] For Louisiana and Oklahoma, Point Sources with only day-specific data use Aug. 17 for Wkd, Aug. 14 for Sat and Aug. 15 for Sun

Table 3-9. Gridded biogenic emissions for states other than Texas.

	13-Aug	14-Aug	15-Aug	16-Aug	17-Aug	18-Aug	19-Aug	20-Aug	21-Aug	22-Aug
NOx (tpd)										
Alabama	78	68	64	70	74	77	74	68	67	68
Arkansas	128	96	94	109	126	134	129	103	102	112
Florida	11	10	9	9	10	10	10	9	9	9
Georgia	51	49	45	47	47	49	48	44	45	46
Illinois	338	271	282	343	385	334	303	292	299	333
Indiana	158	112	121	145	164	144	128	120	130	141
Kansas	444	497	613	689	645	574	494	472	549	549
Kentucky	154	108	113	139	160	149	143	118	122	134
Louisiana	111	102	91	98	106	112	116	106	101	103
Mississippi	133	108	99	113	127	133	137	116	110	118
Missouri	245	215	242	300	314	294	250	235	250	270
Nebraska	148	176	221	226	211	192	170	175	194	192
North Carolina	2	1	1	1	2	1	2	1	1	1
Ohio	22	17	18	20	25	20	19	17	18	20
Oklahoma	196	195	220	238	232	233	202	187	208	216
South Carolina	0	0	0	0	0	0	0	0	0	0
Tennessee	122	86	87	107	120	122	118	93	94	103
Virginia	1	1	0	1	1	1	1	0	0	1
West Virginia	0	0	0	0	1	0	0	0	0	0
NOX Totals	2342	2112	2322	2656	2750	2581	2342	2158	2301	2415
VOC (tpd)										
Alabama	14097	11687	10261	11937	12969	14092	12878	11027	10796	10584
Arkansas	11291	7772	7543	9151	11323	12454	11394	8109	8074	9278
Florida	2772	2287	2158	2335	2424	2413	2501	2227	2391	2268
Georgia	5614	5244	4760	5001	5229	5973	5539	4163	4471	4451
Illinois	1692	982	1211	1758	1987	1250	1215	1236	1343	1558
Indiana	1395	554	823	1163	1421	999	837	747	910	1067
Kansas	973	1127	1674	2129	1944	1678	1204	1015	1365	1136
Kentucky	3596	1383	1808	2922	3641	2991	2727	1654	2109	2645
Louisiana	9282	8317	6817	7615	8392	8981	9574	8468	7649	7784
Mississippi	14325	10911	9068	11206	12666	13599	13921	11249	10355	11261
Missouri	7786	5601	7350	10521	11716	10253	7380	6513	7538	8222
Nebraska	143	225	345	363	330	276	212	225	266	218
North Carolina	602	497	414	512	568	547	565	367	356	388
Ohio	210	86	113	170	234	163	122	110	133	423
Oklahoma	6505	5351	5630	6046	6717	7195	6392	4891	5089	5953
South Carolina	105	102	83	90	95	111	107	70	72	83
Tennessee	8016	3911	4390	6723	7714	7522	7131	4132	4768	5342
Virginia	98	62	46	91	109	91	82	46	50	71
West Virginia	88	37	38	68	93	66	59	36	47	103
VOC Totals	88590	66134	64531	79801	89572	90652	83840	66284	67781	72836
CO (tpd)										
Alabama	1349	1141	1014	1143	1231	1328	1223	1092	1068	1073
Arkansas	1030	752	705	834	1019	1132	1030	776	764	859
Florida	354	313	282	301	309	313	312	291	300	295
Georgia	517	457	411	433	451	495	474	381	391	401
Illinois	166	108	117	155	180	149	136	123	127	146
Indiana	145	82	93	123	147	118	101	90	101	118
Kansas	136	149	205	257	241	210	155	143	176	173
Kentucky	344	196	194	276	337	288	267	195	212	263
Louisiana	953	882	722	791	872	934	1002	885	810	815
Mississippi	1302	1022	847	1011	1142	1232	1246	1036	959	1037
Missouri	610	470	551	742	842	801	594	524	574	630

	13-Aug	14-Aug	15-Aug	16-Aug	17-Aug	18-Aug	19-Aug	20-Aug	21-Aug	22-Aug
Nebraska	21	27	39	42	39	33	26	27	32	31
North Carolina	54	44	38	45	48	46	49	36	33	37
Ohio	20	12	12	16	21	15	13	11	13	51
Oklahoma	559	472	489	529	574	624	538	435	470	537
South Carolina	10	9	7	8	8	9	9	7	7	8
Tennessee	692	427	419	584	668	650	621	439	440	480
Virginia	9	7	5	8	10	8	8	5	5	7
West Virginia	8	5	4	6	8	6	5	4	4	11
CO Totals	8277	6575	6152	7304	8146	8392	7809	6499	6486	6972

DATA SOURCES FOR 2002

A 2002 emission inventory was developed because 2002 was the base year for the attainment demonstration, as discussed in Section 6.

Point Sources

Point source data for the 2002 inventory included:

- 2002 3rd quarter Acid Rain data
- 2000 Texas non-EGU point sources
- 2002 Facility specific data
- 1999 Texas minor point sources
- 1999 NEIv2 point sources

The point source data are processed for a typical peak ozone (PO) season weekday and weekend day.

The point sources processed for the 1999 emissions modeling were the basis of the 2002 modeling point sources emissions. The following adjustments were made to the 1999 processing:

2002 emission estimates for Chemical Eastman Company were provided by NETAC.

The 2002 3rd quarter average NOx emissions from the EPA Acid Rain database were extracted for Texas point specific EGUs. The other Texas point source data is based on the TCEQ 2000 PSDB provided by TCEQ in EPS2x AFS input format. (ftp://ftp.TCEQ.state.tx.us/pub/OEPAA/TAD/Modeling/file_transfer/HGPoints/2000/latlongv12. The Acid Rain NOx was removed from the TCEQ PSDB to avoid double counting of emissions.

The 2002 3rd quarter average NOx emissions from the EPA Acid Rain database were also used for Louisiana, Arkansas and Oklahoma point specific EGUs. The corresponding NOx data was removed from the 1999 NEIv2 inventory to avoid double counting of emission.

For all other states the 1999 NEIv2 was used to estimate 2002 emissions. The EGU data in the ozone season day inventory was adjusted so that each state total matched the 2002 3rd quarter average in the Acid Rain database. The non-EGU data was used at the 1999 levels.

The NOx criterion for selecting plume in grid treatment within the 4km modeling domain is 2 tons NOx on any day. For the regional emissions grid the NOx criterion is 25 tons per day.

Mobile Sources

The Texas Transportation Institute (TTI) prepared mobile source emissions for the counties within the East Texas NNA for 2002. Emission factors are from the EPA's MOBILE6.2 model. Vehicle miles traveled (VMT) for 2002 are based on transportation modeling for Gregg and Smith counties and based on a rural HPMS for Rusk, Harrison and Upshur. All were prepared for four day-of-week scenarios (Weekday, Friday, Saturday and Sunday) and were adjusted to episode day temperature and humidities.

All other Texas counties were based on the 1999 inventory developed by TTI for the four day-of-week scenarios adjusted for episode day temperature and humidities. This inventory was projected to 2002 levels with 2002 VMT and fleet turnover developed by TTI. The data were processed using the same methods described for 1999, above. This resulted in hourly specific mobile source emissions for all Texas counties.

The other states are based on Mobile6.2 emission factors for typical summer day conditions (as used in the NEI99v2) with EPA data for 2002 VMT and fleet turnover.

Area Sources

The area emission estimates for Texas are based on the 1999 processing. The 1999 estimates are projected to 2002 estimates based on EGAS growth factors. The exception is for oil and gas production, which is projected, using the ratio of 2002 to 1999 production values.

For all remaining states, the 1999 NEIv2 emission inventory is projected to 2002 estimates with EGAS growth factors.

Off-Road Sources

Off-road 2002 emissions estimates for the counties within the East Texas NNA were generated using NonRoadv2002 with local data for mining and construction equipment. Aircraft and railroad emissions estimated for 1999 were grown using EGAS growth factors.

NonRoadv2002 with input data developed by TCEQ was run to estimate off-road emissions for the other Texas counties. The aircraft, commercial marine and railroad emissions are taken from the TCEQ 1999 off-road inventory and projected with EGAS growth factors.

For all other states, NonRoadv2002 was used to estimate emissions. The aircraft, commercial marine and railroad emissions were taken from the 1999 NEI v2 inventory and projected to 2002 estimates using EGAS growth factors. The exception was for Oklahoma where the 1999 aircraft, commercial marine and railroad estimates provided by ODEQ were grown with EGAS growth factors.

Biogenic Sources

The preparation of the biogenic emissions using GloBEIS version 3.1 is described at the end of Section 3.

EMISSIONS SUMMARIES FOR 2002

All emission estimates in the following tables reflect gridded, model ready emissions. This means that for partial counties and/or states at the edge of a modeling domain, only the portion of emissions that is within the modeling domain is reported.

Tables 3-10 to 3-12 are episode day emission summaries by major source type for the NNA counties and two Louisiana parishes.

Table 3-13 indicates episode day NOx emissions for the elevated point sources within the 4km grid which have been selected for plume in grid treatment in CAMx modeling. Table 3-14 summarizes total NOx, elevated and surface, for Texas Eastman. Figure 3-2 displays the average episode day NOx for these sources. Table 3-15 lists new facilities in Northeast Texas; sources not present in the 1999 base year modeling.

Table 3-16 represents total gridded Texas emissions for each episode day.

Tables 3-17 and 3-18 summarize the gridded emissions by major source type for states other than Texas.

Table 3-10. 2002 NOx for East Texas NNA and Shreveport area counties.

2002 NOx tons Episode Day	Source	Gregg 48183	Harrison 48203	Rusk 48401	Smith 48423	Upshur 48459	Bossier 22015	Caddo 22017
Friday, August 13	Area	13.4	8.5	13.9	5.8	9.0	4.1	45.6
	Off-road	4.4	5.7	2.4	6.3	2.2	2.8	5.9
	On-road	20.8	17.2	3.8	24.2	2.7	7.1	19.7
	Points	7.1	32.0	57.8	3.8	1.5	3.9	5.3
	Subtotal	45.7	63.3	77.9	40.0	15.3	17.9	76.5
	Biogenics	0.2	0.5	0.5	0.6	0.4	0.6	2.5
	Total	45.9	63.8	78.4	40.6	15.8	18.6	79.0
Saturday, August 14	Area	11.9	8.1	13.7	4.5	8.8	3.8	41.9
	Off-road	3.9	5.1	1.9	5.7	2.1	2.5	5.3
	On-road	14.9	12.8	3.1	17.5	2.0	5.3	14.8
	Points	6.7	32.0	57.8	3.7	1.5	4.0	5.3
	Subtotal	37.4	58.0	76.5	31.4	14.5	15.6	67.3
	Biogenics	0.2	0.5	0.5	0.6	0.4	0.6	2.3
	Total	37.6	58.4	77.0	32.0	14.9	16.2	69.6
Sunday, August 15	Area	10.5	7.7	13.4	3.2	8.7	3.6	40.0
	Off-road	3.3	4.3	1.4	5.0	2.1	2.0	4.4
	On-road	10.8	9.4	2.5	13.1	1.9	5.3	14.8
	Points	6.7	32.0	57.8	3.7	1.5	4.0	5.3
	Subtotal	31.3	53.4	75.1	24.9	14.2	15.0	64.6
	Biogenics	0.2	0.4	0.4	0.6	0.4	0.5	2.2
	Total	31.4	53.8	75.5	25.5	14.5	15.5	66.7
Monday, August 16	Area	13.4	8.5	13.9	5.8	9.0	4.1	45.6
	Off-road	4.4	5.7	2.4	6.3	2.2	2.8	5.9

2002 NOx tons Episode Day	Source	Gregg 48183	Harrison 48203	Rusk 48401	Smith 48423	Upshur 48459	Bossier 22015	Caddo 22017
	On-road	21.5	17.3	3.7	24.0	2.6	7.1	19.7
	Points	7.1	32.0	57.8	3.8	1.5	3.9	5.3
	Subtotal	46.4	63.5	77.9	39.9	15.3	17.9	76.5
	Biogenics	0.2	0.4	0.5	0.6	0.4	0.6	2.3
	Total	46.5	63.9	78.3	40.5	15.7	18.5	78.8
Tuesday, August 17	Area	13.4	8.5	13.9	5.8	9.0	4.1	45.6
	Off-road	4.4	5.7	2.4	6.3	2.2	2.8	5.9
	On-road	21.4	16.5	3.7	23.9	2.7	7.1	19.7
	Points	7.1	32.0	57.8	3.8	1.5	3.9	5.3
	Subtotal	46.2	62.6	77.9	39.8	15.4	17.9	76.5
	Biogenics	0.2	0.5	0.5	0.7	0.5	0.6	2.6
	Total	46.4	63.1	78.4	40.4	15.8	18.6	79.1
Wednesday, August 18	Area	13.4	8.5	13.9	5.8	9.0	4.1	45.6
	Off-road	4.4	5.7	2.4	6.3	2.2	2.8	5.9
	On-road	20.8	17.5	3.8	23.3	2.7	7.1	19.7
	Points	7.1	32.0	57.8	3.8	1.5	3.9	5.3
	Subtotal	45.7	63.7	78.0	39.1	15.3	17.9	76.5
	Biogenics	0.2	0.5	0.5	0.7	0.5	0.7	2.7
	Total	45.9	64.2	78.5	39.8	15.8	18.6	79.2
Thursday, August 19	Area	13.4	8.5	13.9	5.8	9.0	4.1	45.6
	Off-road	4.4	5.7	2.4	6.3	2.2	2.8	5.9
	On-road	20.9	17.5	3.7	23.3	2.6	7.1	19.7
	Points	7.1	32.0	57.8	3.8	1.5	3.9	5.3
	Subtotal	45.7	63.7	77.9	39.2	15.2	17.9	76.5
	Biogenics	0.2	0.6	0.6	0.8	0.5	0.7	3.0
	Total	45.9	64.2	78.5	39.9	15.7	18.7	79.5
Friday, August 20	Area	13.4	8.5	13.9	5.8	9.0	4.1	45.6
	Off-road	4.4	5.7	2.4	6.3	2.2	2.8	5.9
	On-road	20.7	17.6	3.8	24.0	2.7	7.1	19.7
	Points	7.1	32.0	57.8	3.8	1.5	3.9	5.3
	Subtotal	45.5	63.7	78.0	39.8	15.4	17.9	76.5
	Biogenics	0.2	0.5	0.5	0.6	0.4	0.6	2.5
	Total	45.7	64.2	78.5	40.5	15.8	18.6	79.0
Saturday, August 21	Area	11.9	8.1	13.7	4.5	8.8	3.8	41.9
	Off-road	3.9	5.1	1.9	5.7	2.1	2.5	5.3
	On-road	15.3	13.0	3.2	18.0	2.2	5.3	14.8
	Points	6.7	32.0	57.8	3.7	1.5	4.0	5.3
	Subtotal	37.8	58.1	76.6	31.9	14.7	15.6	67.3
	Biogenics	0.2	0.5	0.5	0.6	0.4	0.6	2.4
	Total	38.0	58.6	77.1	32.5	15.1	16.2	69.7
Sunday, August 22	Area	10.5	7.7	13.4	3.2	8.7	3.6	40.0
	Off-road	3.3	4.3	1.4	5.0	2.1	2.0	4.4
	On-road	11.4	9.2	2.6	13.8	1.8	5.3	14.8
	Points	6.7	32.0	57.8	3.7	1.5	4.0	5.3
	Subtotal	31.9	53.2	75.2	25.7	14.1	15.0	64.6
	Biogenics	0.2	0.5	0.5	0.7	0.4	0.6	2.5
	Total	32.1	53.7	75.7	26.3	14.5	15.6	67.1
Average Episode Day	Area	12.7	8.3	13.8	5.2	8.9	4.0	44.3
	Off-road	4.2	5.4	2.2	6.0	2.2	2.7	5.6
	On-road	18.8	15.5	3.5	21.4	2.5	6.6	18.3
	Points	7.0	32.0	57.8	3.7	1.5	4.0	5.3
	Subtotal	42.7	61.2	77.3	36.4	15.0	17.2	73.5
	Biogenics	0.2	0.5	0.5	0.7	0.4	0.6	2.5
	Total	42.9	61.7	77.8	37.1	15.5	17.8	76.0

Table 3-11. 2002 VOC for East Texas NNA and Shreveport area counties.

2002 VOC tons Episode Day	Source	Gregg 48183	Harrison 48203	Rusk 48401	Smith 48423	Upshur 48459	Bossier 22015	Caddo 22017
Friday, August 13	Area	15.7	14.3	12.7	15.3	14.3	6.4	27.5
	Off-road	2.3	1.1	0.8	3.6	0.4	1.5	4.3
	On-road	5.6	5.6	3.1	9.0	2.0	5.1	15.0
	Points	5.6	16.4	2.3	8.6	1.0	1.7	5.8
	Subtotal	29.1	37.3	18.9	36.5	17.7	14.7	52.6
	Biogenics	64.2	325.9	280.4	254.5	154.0	298.7	238.5
	Total	93.3	363.2	299.3	291.0	171.6	313.4	291.2
Saturday, August 14	Area	12.2	12.0	10.7	10.6	13.3	6.4	27.5
	Off-road	2.7	2.2	1.6	5.2	0.6	2.3	7.0
	On-road	5.4	4.4	2.6	8.6	2.5	3.8	11.3
	Points	5.0	15.1	2.3	7.3	1.0	1.7	5.7
	Subtotal	25.4	33.7	17.2	31.7	17.4	14.3	51.4
	Biogenics	61.2	297.1	263.2	234.8	148.9	259.0	205.0
	Total	86.6	330.8	280.4	266.4	166.3	273.3	256.4
Sunday, August 15	Area	10.5	10.9	9.8	7.9	12.6	6.4	27.4
	Off-road	2.6	2.1	1.6	5.0	0.6	2.2	6.8
	On-road	5.6	4.5	3.5	9.0	1.8	3.8	11.3
	Points	5.0	15.1	2.3	7.3	1.0	1.7	5.7
	Subtotal	23.8	32.7	17.2	29.2	16.1	14.2	51.2
	Biogenics	54.5	257.5	231.2	218.1	132.0	218.3	176.4
	Total	78.3	290.2	248.4	247.4	148.0	232.5	227.6
Monday, August 16	Area	15.7	14.3	12.7	15.3	14.3	6.4	27.5
	Off-road	2.3	1.1	0.8	3.6	0.4	1.5	4.3
	On-road	4.9	4.5	2.6	7.8	1.7	5.1	15.0
	Points	5.6	16.4	2.3	8.6	1.0	1.7	5.8
	Subtotal	28.4	36.2	18.4	35.3	17.4	14.7	52.6
	Biogenics	57.9	276.2	240.2	228.2	140.2	236.6	185.4
	Total	86.2	312.4	258.6	263.6	157.6	251.4	238.1
Tuesday, August 17	Area	15.7	14.3	12.7	15.3	14.3	6.4	27.5
	Off-road	2.3	1.1	0.8	3.6	0.4	1.5	4.3
	On-road	5.2	6.2	2.6	8.4	1.7	5.1	15.0
	Points	5.6	16.4	2.3	8.6	1.0	1.7	5.8
	Subtotal	28.7	38.0	18.3	35.9	17.4	14.7	52.6
	Biogenics	64.8	322.8	264.4	250.1	160.9	285.1	225.4
	Total	93.5	360.7	282.8	286.0	178.3	299.8	278.0
Wednesday, August 18	Area	15.7	14.3	12.7	15.3	14.3	6.4	27.5
	Off-road	2.3	1.1	0.8	3.6	0.4	1.5	4.3
	On-road	5.3	4.1	2.5	8.6	1.7	5.1	15.0
	Points	5.6	16.4	2.3	8.6	1.0	1.7	5.8
	Subtotal	28.8	35.8	18.3	36.1	17.4	14.7	52.6
	Biogenics	70.0	343.6	292.5	273.6	168.8	312.2	242.7
	Total	98.8	379.4	310.8	309.6	186.2	326.9	295.4
Thursday, August 19	Area	15.7	14.3	12.7	15.3	14.3	6.4	27.5
	Off-road	2.3	1.1	0.8	3.6	0.4	1.5	4.3
	On-road	5.2	4.1	2.5	8.4	1.6	5.1	15.0
	Points	5.6	16.4	2.3	8.6	1.0	1.7	5.8
	Subtotal	28.7	35.8	18.3	35.9	17.3	14.7	52.6
	Biogenics	76.7	377.5	316.4	299.0	184.4	339.1	267.8
	Total	105.4	413.3	334.7	334.9	201.7	353.8	320.5
Friday, August 20	Area	15.7	14.3	12.7	15.3	14.3	6.4	27.5
	Off-road	2.3	1.1	0.8	3.6	0.4	1.5	4.3
	On-road	6.4	5.1	2.8	10.3	2.1	5.1	15.0
	Points	5.6	16.4	2.3	8.6	1.0	1.7	5.8

2002 VOC tons Episode Day	Source	Gregg 48183	Harrison 48203	Rusk 48401	Smith 48423	Upshur 48459	Bossier 22015	Caddo 22017
	Subtotal	29.9	36.8	18.6	37.8	17.8	14.7	52.6
	Biogenics	65.4	313.7	281.7	254.1	152.4	274.5	220.0
	Total	95.3	350.5	300.3	291.9	170.1	289.2	272.7
Saturday, August 21	Area	12.2	12.0	10.7	10.6	13.3	6.4	27.5
	Off-road	2.7	2.2	1.6	5.2	0.6	2.3	7.0
	On-road	5.6	4.3	2.5	9.0	1.6	3.8	11.3
	Points	5.0	15.1	2.3	7.3	1.0	1.7	5.7
	Subtotal	25.6	33.6	17.2	32.0	16.5	14.3	51.4
	Biogenics	61.8	292.0	258.1	242.2	148.3	253.4	202.4
	Total	87.4	325.6	275.3	274.3	164.8	267.7	253.8
Sunday, August 22	Area	10.5	10.9	9.8	7.9	12.6	6.4	27.4
	Off-road	2.6	2.1	1.6	5.0	0.6	2.2	6.8
	On-road	5.3	4.7	2.4	8.5	1.5	3.8	11.3
	Points	5.0	15.1	2.3	7.3	1.0	1.7	5.7
	Subtotal	23.5	32.8	16.0	28.7	15.8	14.2	51.2
	Biogenics	64.2	308.5	263.8	249.2	155.1	263.5	210.7
	Total	87.7	341.3	279.8	277.9	170.8	277.7	261.9
Average Episode Day	Area	14.4	13.5	12.0	13.6	13.9	6.4	27.5
	Off-road	2.4	1.4	1.0	4.0	0.5	1.7	5.0
	On-road	5.4	4.7	2.7	8.6	1.8	4.7	14.0
	Points	5.4	16.0	2.3	8.2	1.0	1.7	5.8
	Subtotal	27.6	35.6	18.0	34.4	17.1	14.6	52.2
	Biogenics	65.0	316.8	271.8	253.9	157.1	279.5	221.1
	Total	92.6	352.4	289.8	288.4	174.2	294.1	273.4

Table 3-12. 2002 CO for East Texas NNA and Shreveport area counties.

2002 CO tons Episode Day	Source	Gregg 48183	Harrison 48203	Rusk 48401	Smith 48423	Upshur 48459	Bossier 22015	Caddo 22017
Friday, August 13	Area	3.8	7.2	8.5	8.6	5.6	7.4	13.9
	Off-road	41.7	10.1	7.7	53.9	5.1	22.8	60.3
	On-road	75.5	76.7	38.7	121.8	25.3	54.0	158.4
	Points	5.3	11.1	6.6	2.0	0.9	1.8	2.7
	Subtotal	126.2	105.1	61.6	186.4	36.9	85.9	235.2
	Biogenics	5.6	29.9	27.1	22.8	14.6	26.6	21.1
	Total	131.8	135.0	88.7	209.1	51.6	112.5	256.3
Saturday, August 14	Area	3.3	6.5	7.9	6.9	5.1	7.3	13.3
	Off-road	60.1	16.2	12.2	74.3	6.6	30.2	90.6
	On-road	74.8	65.9	34.4	121.7	31.6	40.5	118.8
	Points	4.9	11.1	6.6	1.9	0.9	1.8	2.7
	Subtotal	143.1	99.8	61.0	204.9	44.2	79.8	225.4
	Biogenics	5.6	28.8	27.0	22.4	14.7	23.9	19.3
	Total	148.7	128.6	88.0	227.3	58.9	103.7	244.6
Sunday, August 15	Area	2.8	5.9	7.3	5.2	4.5	7.3	13.0
	Off-road	59.0	15.7	11.8	73.0	6.4	29.5	88.9
	On-road	78.7	67.9	44.5	126.8	24.0	40.5	118.8
	Points	4.9	11.1	6.6	1.9	0.9	1.8	2.7
	Subtotal	145.4	100.6	70.2	207.0	35.9	79.0	223.4
	Biogenics	5.0	25.1	23.7	20.5	13.0	20.6	16.8
	Total	150.4	125.6	93.9	227.4	48.9	99.6	240.2
Monday, August 16	Area	3.8	7.2	8.5	8.6	5.6	7.4	13.9
	Off-road	41.7	10.1	7.7	53.9	5.1	22.8	60.3
	On-road	61.6	61.2	31.5	101.6	21.3	54.0	158.4
	Points	5.3	11.1	6.6	2.0	0.9	1.8	2.7

2002 CO tons Episode Day	Source	Gregg 48183	Harrison 48203	Rusk 48401	Smith 48423	Upshur 48459	Bossier 22015	Caddo 22017
	Subtotal	112.3	89.6	54.3	166.1	32.9	85.9	235.2
	Biogenics	5.4	27.2	24.8	21.8	13.9	22.5	18.1
	Total	117.7	116.8	79.1	187.9	46.8	108.3	253.3
Tuesday, August 17	Area	3.8	7.2	8.5	8.6	5.6	7.4	13.9
	Off-road	41.7	10.1	7.7	53.9	5.1	22.8	60.3
	On-road	64.6	69.2	31.6	106.5	21.2	54.0	158.4
	Points	5.3	11.1	6.6	2.0	0.9	1.8	2.7
	Subtotal	115.3	97.6	54.4	171.0	32.8	85.9	235.2
	Biogenics	6.1	31.6	27.3	24.3	16.1	26.5	21.5
	Total	121.4	129.2	81.7	195.3	48.9	112.4	256.7
Wednesday, August 18	Area	3.8	7.2	8.5	8.6	5.6	7.4	13.9
	Off-road	41.7	10.1	7.7	53.9	5.1	22.8	60.3
	On-road	66.1	82.4	31.3	109.1	21.3	54.0	158.4
	Points	5.3	11.1	6.6	2.0	0.9	1.8	2.7
	Subtotal	116.9	110.8	54.1	173.6	33.0	85.9	235.2
	Biogenics	6.6	33.9	30.4	26.5	17.1	29.3	23.1
	Total	123.4	144.7	84.5	200.2	50.0	115.1	258.4
Thursday, August 19	Area	3.8	7.2	8.5	8.6	5.6	7.4	13.9
	Off-road	41.7	10.1	7.7	53.9	5.1	22.8	60.3
	On-road	66.0	57.2	31.0	108.9	21.2	54.0	158.4
	Points	5.3	11.1	6.6	2.0	0.9	1.8	2.7
	Subtotal	116.7	85.6	53.8	173.4	32.8	85.9	235.2
	Biogenics	7.2	37.6	32.7	28.5	18.6	32.5	25.9
	Total	124.0	123.1	86.5	201.9	51.4	118.4	261.1
Friday, August 20	Area	3.8	7.2	8.5	8.6	5.6	7.4	13.9
	Off-road	41.7	10.1	7.7	53.9	5.1	22.8	60.3
	On-road	82.7	56.9	31.0	133.4	20.3	54.0	158.4
	Points	5.3	11.1	6.6	2.0	0.9	1.8	2.7
	Subtotal	133.4	85.3	53.8	198.0	32.0	85.9	235.2
	Biogenics	5.9	30.3	28.5	23.7	14.8	25.8	20.8
	Total	139.3	115.6	82.3	221.7	46.8	111.6	256.0
Saturday, August 21	Area	3.3	6.5	7.9	6.9	5.1	7.3	13.3
	Off-road	60.1	16.2	12.2	74.3	6.6	30.2	90.6
	On-road	75.6	71.7	36.0	123.1	25.7	40.5	118.8
	Points	4.9	11.1	6.6	1.9	0.9	1.8	2.7
	Subtotal	143.9	105.7	62.7	206.2	38.3	79.8	225.4
	Biogenics	5.6	28.2	26.4	22.8	14.5	23.5	19.0
	Total	149.5	133.8	89.1	229.0	52.8	103.3	244.4
Sunday, August 22	Area	2.8	5.9	7.3	5.2	4.5	7.3	13.0
	Off-road	59.0	15.7	11.8	73.0	6.4	29.5	88.9
	On-road	73.1	65.2	33.0	117.8	22.2	40.5	118.8
	Points	4.9	11.1	6.6	1.9	0.9	1.8	2.7
	Subtotal	139.8	97.8	58.7	198.0	34.1	79.0	223.4
	Biogenics	6.0	30.2	27.6	24.3	15.5	24.8	20.2
	Total	145.8	128.0	86.3	222.3	49.6	103.8	243.6
Average Episode Day	Area	3.6	6.9	8.2	7.9	5.4	7.3	13.7
	Off-road	46.8	11.8	8.9	59.5	5.5	24.8	68.7
	On-road	69.8	67.5	33.4	114.0	22.8	50.1	147.1
	Points	5.2	11.1	6.6	2.0	0.9	1.8	2.7
	Subtotal	125.3	97.3	57.2	183.5	34.6	84.0	232.1
	Biogenics	6.0	30.9	27.9	24.2	15.6	26.2	21.0
	Total	131.3	128.2	85.1	207.7	50.2	110.2	253.2

Table 3-13. Tons/day NOx for several facilities within the 4km domain for 2002 August episode. These represent only the elevated point emissions at each facility.

Facility Name	Data Source	Stack	Weekday	Weekend	Episode Average
Arsenal		1	0.4	0.4	0.4
Arsenal Total	EPA 2002 Q3 Acid Rain Database		0.4	0.4	0.4
Dolet_Hills_Power		1	33.9	33.9	33.9
Dolet_Hills_Power Total	EPA 2002 Q3 Acid Rain Database		33.9	33.9	33.9
Knox_Lee		5	0.3	0.3	0.3
		6	2.2	2.2	2.2
Knox_Lee Total	EPA 2002 Q3 Acid Rain Database		2.5	2.5	2.5
Lieberman		3	0.4	0.4	0.4
		4	0.4	0.4	0.4
Lieberman Total	EPA 2002 Q3 Acid Rain Database		0.8	0.8	0.8
Martin_Lake		5	29.0	29.0	29.0
		6	12.4	12.4	12.4
		7	13.4	13.4	13.4
Martin_Lake Total	EPA 2002 Q3 Acid Rain Database		54.8	54.8	54.8
Monticello		7	10.0	10.0	10.0
		9	17.4	17.4	17.4
		10	17.1	17.1	17.1
Monticello Total	EPA 2002 Q3 Acid Rain Database		44.5	44.5	44.5
Pirkey		1	13.6	13.6	13.6
Pirkey Total	EPA 2002 Q3 Acid Rain Database		13.6	13.6	13.6
Stryker_Creek		1	3.5	3.5	3.5
		3	1.4	1.4	1.4
		4	2	2	2.0
Stryker_Creek Total	EPA 2002 Q3 Acid Rain Database	0	6.9	6.9	6.9
Tenaska		1	0.5	0.5	0.5
		2	0.4	0.4	0.4
		3	0.4	0.4	0.4
Tenaska Total	EPA 2002 Q3 Acid Rain Database		1.3	1.3	1.3
Welsh		11	11.1	11.1	11.1
		12	21.2	21.2	21.2
		13	10.5	10.5	10.5
Welsh Total	EPA 2002 Q3 Acid Rain Database		42.8	42.8	42.8
Wilkes		1	2.6	2.6	2.6
		2	2.3	2.3	2.3
		3	0.8	0.8	0.8
Wilkes Total	EPA 2002 Q3 Acid Rain Database		5.7	5.7	5.7

Note: The August 2002 episode consists of the dates Aug. 13-22. Weekday dates correspond to Aug. 13 and Aug. 16-20. Weekend dates are Aug. 14-15 and Aug. 21-22.

Table 3-14. Eastman Chemical Co. total elevated and surface NOx tpd for average August 2002 episode day. The 'other' represents over a hundred individual stacks.

	Cogen Unit Stack 1	Cogen Unit Stack 2	Other Elevated	Other Surface	Total
NOx	1.05	1.05	6.2	1.0	9.3
VOC	0.0	0.0	0.9	10.8	11.8

Note: The cogen unit emissions are not actually Eastman Chemical Co. emissions, but are included in this table because Eastman agreed to offset the cogen emissions as part of their overall NOx reduction commitment.

Table 3-15. 'New' point sources in Northeast Texas. Sources in the 2002 modeling which were not present in the 1999 base year modeling.

Facility Name	County	NOx
Tenaska	Rusk	1.3

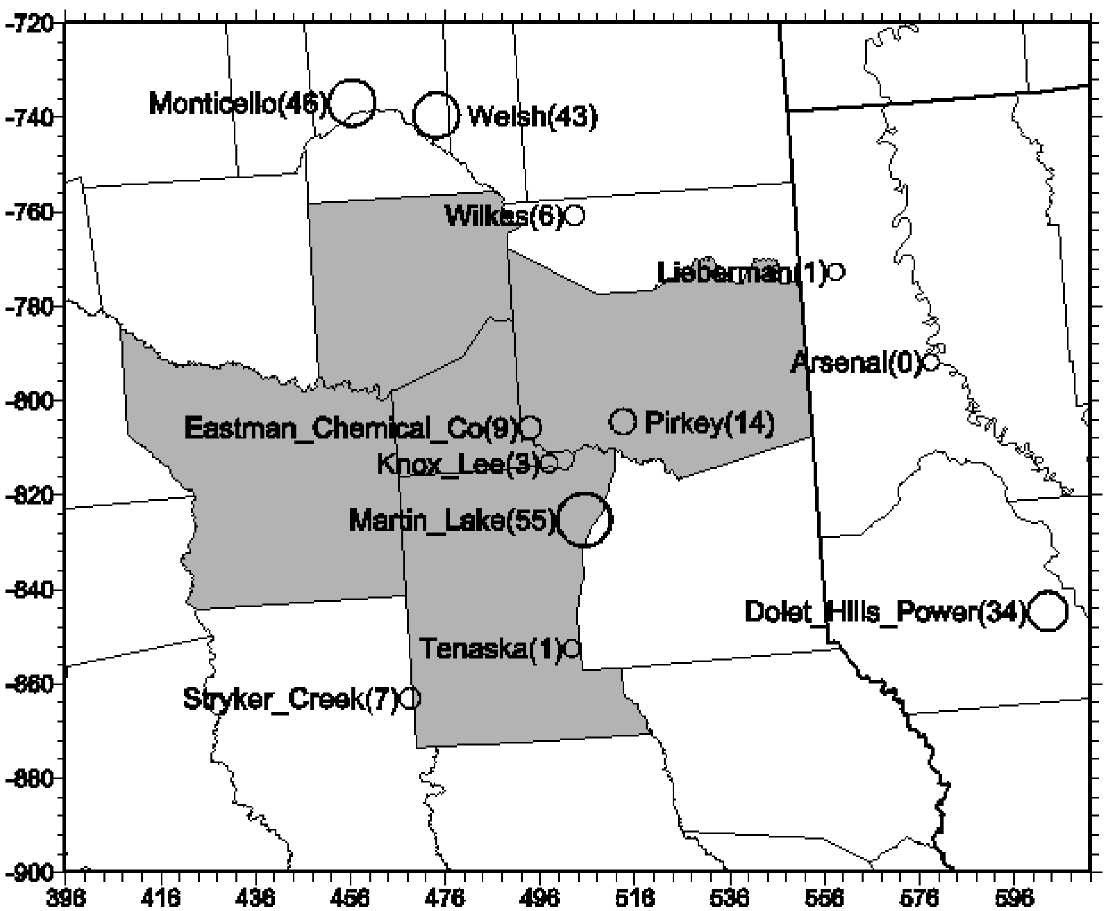


Figure 3-2. 2002 average episode day NOx for the facilities in Table 3-13. These represent elevated sources for all facilities with the exception of Eastman Chemical which represents the total NOx from Table 3-14.

Table 3-16. Texas gridded 2002 episode day emissions by major source type.

Episode Day	Area	Off-road	On-road	EGUs	Other Points	Off Shore	Ship-ping	Total Anthro-pogenic	Bio-genic	Total
Tons NOx										
Friday, August 13	647	934	1281	781	871	549	37	5100	1100	6200
Saturday, August 14	629	910	894	781	871	549	37	4671	1082	5753
Sunday, August 15	611	841	686	781	871	549	37	4376	1105	5481
Monday, August 16	647	934	1317	781	871	549	37	5136	1082	6218
Tuesday, August 17	647	934	1305	781	871	549	37	5124	1040	6164
Wednesday, August 18	647	934	1303	781	871	549	37	5122	1078	6200
Thursday, August 19	647	934	1322	781	871	549	37	5142	1068	6209
Friday, August 20	647	934	1315	781	871	549	37	5134	1052	6186
Saturday, August 21	629	910	899	781	871	549	37	4677	1053	5730
Sunday, August 22	611	841	676	781	871	549	37	4366	1010	5376
Tons VOC										
Friday, August 13	1816	447	898	20	485	189	1	3856	22087	25943
Saturday, August 14	1441	823	665	20	460	189	1	3599	20527	24126
Sunday, August 15	1227	810	563	20	460	189	1	3271	20445	23716
Monday, August 16	1816	447	775	20	485	189	1	3734	19998	23732
Tuesday, August 17	1816	447	766	20	485	189	1	3725	19290	23015
Wednesday, August 18	1816	447	774	20	485	189	1	3733	20752	24485
Thursday, August 19	1816	447	798	20	485	189	1	3756	21745	25501
Friday, August 20	1816	447	922	20	485	189	1	3881	20788	24668
Saturday, August 21	1441	823	653	20	460	189	1	3587	19565	23152
Sunday, August 22	1227	810	556	20	460	189	1	3264	18023	21287
Tons CO										
Friday, August 13	969	5704	11950	219	702	126	6	19676	2270	21946
Saturday, August 14	832	8251	9233	219	699	126	6	19366	2159	21525
Sunday, August 15	699	8121	7944	219	699	126	6	17814	2128	19941
Monday, August 16	969	5704	10273	219	702	126	6	17999	2078	20077
Tuesday, August 17	969	5704	10234	219	702	126	6	17960	2005	19965
Wednesday, August 18	969	5704	10393	219	702	126	6	18119	2136	20254
Thursday, August 19	969	5704	10485	219	702	126	6	18210	2212	20423
Friday, August 20	969	5704	11884	219	702	126	6	19610	2127	21737
Saturday, August 21	832	8251	9027	219	699	126	6	19161	2045	21206
Sunday, August 22	699	8121	7991	219	699	126	6	17860	1963	19823

Table 3-17. Summary of August 2002 gridded emissions by major source type for states other than Texas.

	Area			Off-road			On-road			Point			Anthropogenic		
State	Week day	Sat	Sun	Weekday	Sat	Sun	Week day	Sat	Sun	Week day	Sat	Sun	Total Week day	Total Sat	Total Sun
NOx															
Alabama	37	36	35	481	484	468	436	327	327	673	659	659	1626	1505	1488
Arkansas	121	112	107	152	151	140	265	199	199	335	334	334	874	796	780
Florida	7	7	7	31	40	35	114	85	85	186	186	186	338	317	313
Georgia	74	70	68	156	141	118	627	470	470	336	331	331	1193	1013	987
Illinois	13	13	12	206	204	197	203	152	152	339	388	388	761	756	748
Indiana	33	31	30	141	134	123	220	165	165	642	647	647	1037	978	966
Kansas	35	32	31	231	221	207	238	178	178	466	431	431	969	862	847
Kentucky	255	235	225	230	228	215	417	312	312	677	671	671	1579	1447	1423
Louisiana	343	315	302	671	678	661	364	273	273	941	939	939	2319	2205	2174
Mississippi	6	6	6	193	195	184	321	241	241	422	422	422	942	864	853
Missouri	181	169	162	352	359	336	553	415	415	529	531	531	1616	1473	1444
Nebraska	4	4	4	40	39	39	16	12	12	28	10	10	87	65	64
North Carolina	1	1	1	3	3	2	18	14	14	13	13	13	35	30	30
Ohio	25	23	22	94	88	80	125	94	94	568	566	566	813	770	762
Oklahoma	74	68	65	311	312	302	368	276	276	530	548	548	1282	1204	1190

	Area			Off-road			On-road			Point			Anthropogenic		
State	**Week day**	**Sat**	**Sun**	**Weekday**	**Sat**	**Sun**	**Week day**	**Sat**	**Sun**	**Week day**	**Sat**	**Sun**	**Total Week day**	**Total Sat**	**Total Sun**
South Carolina	0	0	0	0	0	0	4	3	3	0	0	0	5	4	4
Tennessee	65	61	59	232	228	206	527	395	395	647	668	668	1470	1352	1328
Virginia	1	1	1	2	2	1	8	6	6	2	0	0	13	9	9
West Virginia	3	3	3	34	33	32	14	11	11	105	105	105	156	152	151
Grand Total	1278	1185	1139	3560	3540	3344	4838	3628	3628	7439	7448	7448	17115	15802	15560
VOC															
Alabama	510	510	510	134	309	306	332	249	249	207	166	166	1184	1233	1230
Arkansas	410	409	409	80	185	183	171	128	128	97	84	84	758	806	804
Florida	131	131	131	46	159	158	80	60	60	117	114	114	374	464	463
Georgia	441	441	441	133	201	196	407	305	305	70	51	51	1050	997	993
Illinois	219	219	219	60	104	103	117	88	88	87	69	69	483	480	478
Indiana	302	302	302	54	88	86	136	102	102	82	53	53	573	544	542
Kansas	338	338	338	82	121	118	152	114	114	85	52	52	657	625	622
Kentucky	422	422	422	93	207	204	257	192	192	208	149	149	980	971	968
Louisiana	435	435	435	150	378	375	232	174	174	253	260	260	1070	1247	1243
Mississippi	455	455	455	79	200	199	198	149	149	168	165	165	901	969	967
Missouri	984	984	984	195	440	436	350	263	263	125	95	95	1655	1782	1777
Nebraska	45	45	45	8	12	12	10	7	7	3	3	3	66	67	67
North Carolina	18	18	18	5	10	10	10	7	7	7	5	5	40	40	40
Ohio	162	162	162	47	55	54	85	64	64	17	13	13	311	294	293
Oklahoma	331	331	331	98	202	200	266	200	200	106	97	97	801	829	827
South Carolina	2	2	2	0	0	0	3	2	2	0	0	0	5	4	4
Tennessee	749	748	748	132	292	288	337	252	252	297	164	164	1514	1457	1453
Virginia	8	8	8	1	1	1	5	4	4	2	0	0	16	13	13
West Virginia	24	24	24	5	12	12	9	7	7	9	8	8	48	51	51
Grand Total	5985	5984	5983	1402	2977	2941	3156	2367	2367	1943	1547	1547	12487	12874	12837
CO															
Alabama	246	246	246	1251	2062	2029	3433	2575	2575	479	436	436	5410	5319	5286
Arkansas	122	121	120	726	1205	1181	1931	1449	1449	297	293	293	3077	3068	3043
Florida	61	61	61	371	763	755	837	628	628	601	600	600	1869	2051	2044
Georgia	504	503	502	1955	2738	2691	4635	3476	3476	192	180	180	7286	6897	6849
Illinois	38	38	38	708	978	962	1363	1022	1022	104	104	104	2212	2141	2125
Indiana	94	93	92	725	964	941	1529	1146	1146	181	154	154	2528	2358	2335
Kansas	89	86	85	1061	1421	1392	1736	1302	1302	248	235	235	3134	3044	3014
Kentucky	203	199	197	954	1541	1512	2827	2121	2121	295	285	285	4279	4145	4115
Louisiana	185	181	179	1232	2187	2156	2657	1993	1993	860	869	869	4934	5229	5196
Mississippi	125	125	125	675	1178	1156	1935	1451	1451	194	193	193	2928	2947	2925
Missouri	376	373	371	2203	3418	3369	3806	2854	2854	311	306	306	6696	6952	6901
Nebraska	3	3	3	95	129	128	105	79	79	4	3	3	207	214	213
North Carolina	17	17	17	48	68	67	117	88	88	9	9	9	191	182	181
Ohio	64	63	63	810	976	959	915	686	686	96	91	91	1884	1816	1799
Oklahoma	85	84	83	1011	1563	1542	2747	2060	2060	192	191	191	4034	3898	3876
South Carolina	3	3	3	1	1	1	29	22	22	0	0	0	33	25	25
Tennessee	268	267	266	1450	2290	2244	3759	2820	2820	267	272	272	5745	5649	5602
Virginia	5	5	5	11	15	15	54	40	40	1	1	1	72	61	61
West Virginia	12	12	12	51	81	79	102	77	77	14	13	13	179	183	181
Grand Total	2500	2479	2469	15338	23578	23178	34516	25887	25887	4344	4234	4234	56698	56178	55768

Table 3-18. Gridded biogenic emissions for states other than Texas.

	13-Aug	14-Aug	15-Aug	16-Aug	17-Aug	18-Aug	19-Aug	20-Aug	21-Aug	22-Aug
NOx (tpd)										
Alabama	78	68	64	70	74	77	74	68	67	68
Arkansas	128	96	94	109	126	134	129	103	102	112
Florida	11	10	9	9	10	10	10	9	9	9
Georgia	51	49	45	47	47	49	48	44	45	46
Illinois	338	271	282	343	385	334	303	292	299	333
Indiana	158	112	121	145	164	144	128	120	130	141
Kansas	444	497	613	689	645	574	494	472	549	549
Kentucky	154	108	113	139	160	149	143	118	122	134
Louisiana	111	102	91	98	106	112	116	106	101	103
Mississippi	133	108	99	113	127	133	137	116	110	118
Missouri	245	215	242	300	314	294	250	235	250	270
Nebraska	148	176	221	226	211	192	170	175	194	192
North Carolina	2	1	1	1	2	1	2	1	1	1
Ohio	22	17	18	20	25	20	19	17	18	20
Oklahoma	196	195	220	238	232	233	202	187	208	216
South Carolina	0	0	0	0	0	0	0	0	0	0
Tennessee	122	86	87	107	120	122	118	93	94	103
Virginia	1	1	0	1	1	1	1	0	0	1
West Virginia	0	0	0	0	1	0	0	0	0	0
NOX Totals	2342	2112	2322	2656	2750	2581	2342	2158	2301	2415
VOC (tpd)										
Alabama	14097	11687	10261	11937	12969	14092	12878	11027	10796	10584
Arkansas	11291	7772	7543	9151	11323	12454	11394	8109	8074	9278
Florida	2772	2287	2158	2335	2424	2413	2501	2227	2391	2268
Georgia	5614	5244	4760	5001	5229	5973	5539	4163	4471	4451
Illinois	1692	982	1211	1758	1987	1250	1215	1236	1343	1558
Indiana	1395	554	823	1163	1421	999	837	747	910	1067
Kansas	973	1127	1674	2129	1944	1678	1204	1015	1365	1136
Kentucky	3596	1383	1808	2922	3641	2991	2727	1654	2109	2645
Louisiana	9282	8317	6817	7615	8392	8981	9574	8468	7649	7784
Mississippi	14325	10911	9068	11206	12666	13599	13921	11249	10355	11261
Missouri	7786	5601	7350	10521	11716	10253	7380	6513	7538	8222
Nebraska	143	225	345	363	330	276	212	225	266	218
North Carolina	602	497	414	512	568	547	565	367	356	388
Ohio	210	86	113	170	234	163	122	110	133	423
Oklahoma	6505	5351	5630	6046	6717	7195	6392	4891	5089	5953
South Carolina	105	102	83	90	95	111	107	70	72	83
Tennessee	8016	3911	4390	6723	7714	7522	7131	4132	4768	5342
Virginia	98	62	46	91	109	91	82	46	50	71
West Virginia	88	37	38	68	93	66	59	36	47	103
VOC Totals	88590	66134	64531	79801	89572	90652	83840	66284	67781	72836
CO (tpd)										
Alabama	1349	1141	1014	1143	1231	1328	1223	1092	1068	1073
Arkansas	1030	752	705	834	1019	1132	1030	776	764	859
Florida	354	313	282	301	309	313	312	291	300	295
Georgia	517	457	411	433	451	495	474	381	391	401
Illinois	166	108	117	155	180	149	136	123	127	146
Indiana	145	82	93	123	147	118	101	90	101	118
Kansas	136	149	205	257	241	210	155	143	176	173
Kentucky	344	196	194	276	337	288	267	195	212	263
Louisiana	953	882	722	791	872	934	1002	885	810	815
Mississippi	1302	1022	847	1011	1142	1232	1246	1036	959	1037
Missouri	610	470	551	742	842	801	594	524	574	630

	13-Aug	14-Aug	15-Aug	16-Aug	17-Aug	18-Aug	19-Aug	20-Aug	21-Aug	22-Aug
Nebraska	21	27	39	42	39	33	26	27	32	31
North Carolina	54	44	38	45	48	46	49	36	33	37
Ohio	20	12	12	16	21	15	13	11	13	51
Oklahoma	559	472	489	529	574	624	538	435	470	537
South Carolina	10	9	7	8	8	9	9	7	7	8
Tennessee	692	427	419	584	668	650	621	439	440	480
Virginia	9	7	5	8	10	8	8	5	5	7
West Virginia	8	5	4	6	8	6	5	4	4	11
CO Totals	8277	6575	6152	7304	8146	8392	7809	6499	6486	6972

DATA SOURCES FOR 2007

Point Sources

Point source data were obtained from several different sources, processed separately and merged prior to modeling. The data include:

- Texas electric generating units (EGUs)
- Texas non-EGU point sources
- Facility specific data
- Texas minor point sources
- Other State point sources

The point source data are processed for a typical peak ozone (PO) season weekday and weekend day.

The 2007 Texas point source data were provided by TCEQ in EPS2x AFS input format. The hourly EGU data are developed from the EPA's Acid Rain Program Database and are based on 30-day peaks at each facility in the summer quarter of 1997, 1998 and 1999. These data include 'new' sources within 100 miles of the non-attainment areas. Controls are applied to the EGU data to represent TCEQ's NOx rules. The TCEQ Point Source Data Base (PSDB) is the basis of the non-EGU Texas data. These data were provided as 2007 estimates and incorporated growth and controls. The files which were downloaded from the TCEQ ftp site ftp://ftp.TCEQ.state.tx.us/pub/AirQuality/AirQualityPlanningAssessment/Modeling/file_transfer/HGPoints/forDec2000SIP/ are:

TX EGU	hourly_NAA30dayTXegu.afs_newEGU100miDFWandHGA_11
TX Non-EGU	afs.tx_negu.930905-930911_12.tier2_07.NewNEGU.new

Many facilities in the Northeast Texas region provided future year emission estimates in developing the Northeast Texas Region Ozone SIP Revision (March, 2002) which are used in this modeling inventory. These sources were removed from the Texas files listed above and replaced with the provided SIP data. In addition, permits for new EGU units in the Northeast Texas region were researched and emission estimates were provided via email from TCEQ's Ron Thomas.

For all states other than Texas the U.S. EPA 2007 national inventories developed to assist future modeling of the Heavy-Duty Engine and Vehicle Standards and Highway Diesel Fuel, henceforth referred to as 2007 HDD inventory, were downloaded from EPA's ftp site.

ftp://ftp.epa.gov/EmisInventory/HDD_Rule/2007BaseCase/

Regional EGU	Egu/eg07ms2h.zip
Regional Non-EGU	NonEGUPoint/pt07ms2h.zip

The compressed files (*.zip*) contain a Dbase/FoxPro formatted file (*.dbf*) which were converted to Ascii text (*.dat*) for processing. The data is processed to (1) extract peak ozone season data for those states within the regional modeling domain other than Texas, (2) reformatted to EPS2x AFS input file format and (3) processed through EPS2x. The 2007 HDD inventories are described in detail in *Procedures for Developing Base Year and Future Year Mass and Modeling Inventories for the Heavy-Duty Engine and Vehicle Standards and Highway Diesel Fuel (HDD) Rulemaking* (ftp://ftp.epa.gov/EmisInventory/HDD_Rule/ProceduresDocument/ProcRptFinal.wpd).

The NOx criterion for selecting plume in grid treatment within the 4km modeling domain is 2 tons NOx on any day. For the regional emissions grid the NOx criterion is 25 tons per day.

Mobile Sources

The Texas Transportation Institute (TTI) prepared mobile source emissions for all Texas counties under contract to the TCEQ. Emission factors are from the EPA's MOBILE6 model. Vehicle miles traveled (VMT) for 2007 are based on transportation models in all NNA counties that have a complete transportation model and were based on a rural HPMS method elsewhere. The NNA counties for which link based transportation model data are used:

East Texas:	Gregg, Smith
Austin:	Hays, Travis, Williamson
San Antonio:	Bexar
Corpus Christi:	Nueces, San Patricio
Victoria:	Victoria

The 2007 TTI data were processed using the same methods described for 1999, above. The result of this processing was a mobile emissions inventory that accurately reflects the temperature and humidity in a given county during the modeling period.

The other states are based on Mobile6.2 emission factors for typical summer day conditions (as used in the NEI99v2) with EPA data for 2007 VMT and fleet turnover.

Area Sources

Area 1999 emissions estimates for the counties within the East Texas NNA were provided by Pollution Solutions. Refer to "Tyler/Longview/Marshall Flexible Attainment Region Emission Inventory Ozone Precursors, VOC, NOx and CO 1999 Emissions" May, 2002 for a detailed description of the inventory development. These data were provided via email by Jerry Demo of Pollution Solutions. The 1999 TCEQ area source data outside the East Texas NNA is the basis of the other Texas counties. The area source data were grown to 2007 estimates with factors by source classification code generated using EGAS 4.0. The exception is for oil and gas production which is projected using the ratio of 2007 to 1999 production values. In addition, control factors were applied by county based on the documented SIP rules in Coulter-Burke, et al., (2002).

For all remaining areas, EPA's 2007 HDD inventories are the basis for the area regional emissions inventory. The HDD 2007 area emission inventory is (1) processed to extract the typical peak ozone season day data, (2) reformatted to the EPS2x AMS input file format and (3) processed through EPS2x.

ftp://ftp.epa.gov/EmisInventory/HDD_Rule/2007BaseCase/Area_Nonroad

Regional Area	ar07ms2h.zip

Off-Road Sources

Off-road 2007 emissions estimates for the counties within the East Texas NNA were generated using NonRoadv2002 with local data for mining and construction equipment. Aircraft and railroad emissions estimated for 1999 were grown using EGAS growth factors. NonRoadv2002 with input data developed by TCEQ was run to estimate off-road emissions for the other Texas counties. The aircraft, commercial marine and railroad emissions are taken from the TCEQ 1999 off-road inventory and projected with EGAS growth factors.

For all other states, NonRoadv2002 was used to estimate emissions. The aircraft, commercial marine and railroad emissions were taken from EPA's 2007 HDD off-road inventory. The HDD 2007 off-road emission inventory is (1) processed to extract the typical peak ozone season day data, (2) reformatted to the EPS2x AMS input file format and (3) processed through EPS2x.

ftp://ftp.epa.gov/EmisInventory/HDD_Rule/2007ControlCase/Area_Nonroad

Regional Non-road	n7ms1hc.zip

Biogenic Sources

Biogenic emissions were prepared using version 3.1 of the GloBEIS model (Yarwood et al., 2002). These data were developed for the 1999 base case modeling and are identical for the 2007 modeling inventory.

EMISSIONS SUMMARIES FOR 2007

All emission estimates in the following tables reflect gridded, model ready emissions. This means that for partial counties and/or states at the edge of a modeling domain, only the portion of emissions that is within the modeling domain is reported.

Tables 3-19 to 3-21 are episode day emission summaries by major source type for the NNA counties and two Louisiana parishes.

Table 3-22 indicates episode day NOx emissions for the elevated point sources within the 4km grid which have been selected for plume in grid treatment in CAMx modeling. Table 3-23 summarizes total NOx, elevated and surface, for Eastman Chemical Co. Figure 3-3 displays the average episode day NOx for these sources. Table 3-24 lists new facilities in Northeast Texas; sources not present in the 1999 base year modeling.

Table 3-25 represents total gridded Texas emissions for each episode day.

Tables 3-26 and 3-27 summarize the gridded emissions by major source type for states other than Texas.

Table 3-19. 2007 NOx for East Texas NNA and Shreveport area counties.

2007 NOx tons Episode Day	Source	Gregg 48183	Harrison 48203	Rusk 48401	Smith 48423	Upshur 48459	Bossier 22015	Caddo 22017
Friday, August 13	Area	13.8	8.6	14.2	6.0	9.1	4.1	47.6
	Off-road	4.0	4.3	1.8	5.6	1.8	4.3	9.8
	On-road	5.9	18.5	4.7	10.4	3.9	5.1	14.1
	Points	14.5	35.7	63.1	4.3	1.0	4.4	7.8
	Subtotal	38.2	67.2	83.8	26.3	15.7	17.9	79.4
	Biogenics	0.2	0.5	0.5	0.6	0.4	0.6	2.5
	Total	38.3	67.6	84.3	26.9	16.2	18.6	81.8
Saturday, August 14	Area	12.2	8.2	13.9	4.6	8.9	3.8	43.8
	Off-road	3.6	3.9	1.5	5.2	1.7	4.0	9.4
	On-road	4.2	13.7	3.8	7.5	3.1	3.8	10.6
	Points	14.5	35.7	63.1	4.3	1.0	4.4	7.6
	Subtotal	34.5	61.5	82.3	21.6	14.8	16.1	71.3
	Biogenics	0.2	0.5	0.5	0.6	0.4	0.6	2.3
	Total	34.7	62.0	82.7	22.2	15.2	16.6	73.6
Sunday, August 15	Area	10.7	7.8	13.6	3.3	8.8	3.6	41.8
	Off-road	3.0	3.4	1.1	4.5	1.7	3.6	8.6
	On-road	2.9	10.4	3.1	5.5	2.6	3.8	10.6
	Points	14.5	35.7	63.1	4.3	1.0	4.4	7.6
	Subtotal	31.2	57.3	80.9	17.5	14.1	15.5	68.6
	Biogenics	0.2	0.4	0.4	0.6	0.4	0.5	2.2
	Total	31.4	57.7	81.3	18.1	14.4	16.0	70.7
Monday, August 16	Area	13.8	8.6	14.2	6.0	9.1	4.1	47.6
	Off-road	4.0	4.3	1.8	5.6	1.8	4.3	9.8
	On-road	6.5	18.9	4.8	11.2	3.9	5.1	14.1
	Points	14.5	35.7	63.1	4.3	1.0	4.4	7.8
	Subtotal	38.7	67.6	83.9	27.1	15.8	17.9	79.4
	Biogenics	0.2	0.4	0.5	0.6	0.4	0.6	2.3
	Total	38.9	68.0	84.3	27.7	16.2	18.5	81.6
Tuesday, August 17	Area	13.8	8.6	14.2	6.0	9.1	4.1	47.6
	Off-road	4.0	4.3	1.8	5.6	1.8	4.3	9.8

2007 NOx tons Episode Day	Source	Gregg 48183	Harrison 48203	Rusk 48401	Smith 48423	Upshur 48459	Bossier 22015	Caddo 22017
	On-road	6.5	18.9	4.8	11.1	4.0	5.1	14.1
	Points	14.5	35.7	63.1	4.3	1.0	4.4	7.8
	Subtotal	38.7	67.5	83.9	27.1	15.8	17.9	79.4
	Biogenics	0.2	0.5	0.5	0.7	0.5	0.6	2.6
	Total	38.9	68.0	84.4	27.7	16.3	18.6	81.9
Wednesday, August 18	Area	13.8	8.6	14.2	6.0	9.1	4.1	47.6
	Off-road	4.0	4.3	1.8	5.6	1.8	4.3	9.8
	On-road	6.1	18.8	4.8	10.5	3.9	5.1	14.1
	Points	14.5	35.7	63.1	4.3	1.0	4.4	7.8
	Subtotal	38.3	67.4	83.9	26.4	15.8	17.9	79.4
	Biogenics	0.2	0.5	0.5	0.7	0.5	0.7	2.7
	Total	38.5	67.9	84.4	27.1	16.2	18.6	82.1
Thursday, August 19	Area	13.8	8.6	14.2	6.0	9.1	4.1	47.6
	Off-road	4.0	4.3	1.8	5.6	1.8	4.3	9.8
	On-road	6.4	18.8	4.8	11.1	3.9	5.1	14.1
	Points	14.5	35.7	63.1	4.3	1.0	4.4	7.8
	Subtotal	38.7	67.4	83.8	27.0	15.7	17.9	79.4
	Biogenics	0.2	0.6	0.6	0.8	0.5	0.7	3.0
	Total	38.9	68.0	84.4	27.8	16.3	18.7	82.3
Friday, August 20	Area	13.8	8.6	14.2	6.0	9.1	4.1	47.6
	Off-road	4.0	4.3	1.8	5.6	1.8	4.3	9.8
	On-road	5.7	18.4	4.9	10.0	3.9	5.1	14.1
	Points	14.5	35.7	63.1	4.3	1.0	4.4	7.8
	Subtotal	38.0	67.0	83.9	26.0	15.8	17.9	79.4
	Biogenics	0.2	0.5	0.5	0.6	0.4	0.6	2.5
	Total	38.2	67.5	84.4	26.6	16.2	18.6	81.9
Saturday, August 21	Area	12.2	8.2	13.9	4.6	8.9	3.8	43.8
	Off-road	3.6	3.9	1.5	5.2	1.7	4.0	9.4
	On-road	4.2	13.6	3.9	7.6	3.1	3.8	10.6
	Points	14.5	35.7	63.1	4.3	1.0	4.4	7.6
	Subtotal	34.5	61.4	82.4	21.7	14.8	16.1	71.3
	Biogenics	0.2	0.5	0.5	0.6	0.4	0.6	2.4
	Total	34.7	61.9	82.8	22.3	15.2	16.6	73.7
Sunday, August 22	Area	10.7	7.8	13.6	3.3	8.8	3.6	41.8
	Off-road	3.0	3.4	1.1	4.5	1.7	3.6	8.6
	On-road	3.2	10.1	3.1	5.9	2.6	3.8	10.6
	Points	14.5	35.7	63.1	4.3	1.0	4.4	7.6
	Subtotal	31.4	57.0	80.9	17.9	14.0	15.5	68.6
	Biogenics	0.2	0.5	0.5	0.7	0.4	0.6	2.5
	Total	31.6	57.4	81.4	18.6	14.5	16.1	71.1
Average Episode Day	Area	13.1	8.5	14.0	5.4	9.0	4.0	46.3
	Off-road	3.8	4.1	1.7	5.4	1.7	4.2	9.6
	On-road	5.5	16.8	4.4	9.6	3.6	4.7	13.1
	Points	14.5	35.7	63.1	4.3	1.0	4.4	7.7
	Subtotal	36.9	65.1	83.2	24.7	15.4	17.3	76.7
	Biogenics	0.2	0.5	0.5	0.7	0.4	0.6	2.5
	Total	37.1	65.6	83.7	25.4	15.8	17.9	79.2

Table 3-20. 2007 VOC for East Texas NNA and Shreveport area counties.

2007 VOC tons Episode Day	Source	Gregg 48183	Harrison 48203	Rusk 48401	Smith 48423	Upshur 48459	Bossier 22015	Caddo 22017
Friday, August 13	Area	16.2	14.8	13.2	15.9	14.7	5.4	22.6
	Off-road	1.7	1.0	0.6	3.0	0.3	1.9	4.9
	On-road	4.5	7.6	3.7	8.4	2.6	3.5	10.2
	Points	7.1	18.0	2.4	10.9	1.1	1.2	3.9
	Subtotal	29.5	41.4	20.0	38.2	18.7	11.9	41.6
	Biogenics	64.2	325.9	280.4	254.5	154.0	298.7	238.5
	Total	93.7	367.3	300.4	292.6	172.7	310.6	280.1
Saturday, August 14	Area	12.6	12.3	10.9	11.1	13.6	5.4	22.5
	Off-road	2.1	2.0	1.4	4.4	0.5	2.5	7.6
	On-road	3.6	6.1	3.0	6.8	2.2	2.6	7.7
	Points	7.1	18.0	2.4	10.9	1.1	1.2	3.9
	Subtotal	25.5	38.4	17.7	33.2	17.4	11.7	41.6
	Biogenics	61.2	297.1	263.2	234.8	148.9	259.0	205.0
	Total	86.7	335.5	280.9	268.0	166.3	270.7	246.6
Sunday, August 15	Area	10.6	11.1	9.9	8.0	12.8	5.4	22.5
	Off-road	2.1	2.0	1.4	4.3	0.5	2.5	7.4
	On-road	2.6	5.8	2.5	4.8	2.1	2.6	7.7
	Points	7.1	18.0	2.4	10.9	1.1	1.2	3.9
	Subtotal	22.3	36.9	16.2	28.0	16.6	11.7	41.5
	Biogenics	54.5	257.5	231.2	218.1	132.0	218.3	176.4
	Total	76.9	294.4	247.5	246.1	148.5	229.9	217.8
Monday, August 16	Area	16.2	14.8	13.2	15.9	14.7	5.4	22.6
	Off-road	1.7	1.0	0.6	3.0	0.3	1.9	4.9
	On-road	3.2	6.2	3.3	5.9	2.3	3.5	10.2
	Points	7.1	18.0	2.4	10.9	1.1	1.2	3.9
	Subtotal	28.2	40.1	19.6	35.6	18.4	11.9	41.6
	Biogenics	57.9	276.2	240.2	228.2	140.2	236.6	185.4
	Total	86.0	316.3	259.8	263.9	158.6	248.6	227.0
Tuesday, August 17	Area	16.2	14.8	13.2	15.9	14.7	5.4	22.6
	Off-road	1.7	1.0	0.6	3.0	0.3	1.9	4.9
	On-road	3.3	6.0	3.3	6.1	2.3	3.5	10.2
	Points	7.1	18.0	2.4	10.9	1.1	1.2	3.9
	Subtotal	28.3	39.9	19.6	35.9	18.4	11.9	41.6
	Biogenics	64.8	322.8	264.4	250.1	160.9	285.1	225.4
	Total	93.1	362.6	284.0	286.0	179.3	297.0	267.0
Wednesday, August 18	Area	16.2	14.8	13.2	15.9	14.7	5.4	22.6
	Off-road	1.7	1.0	0.6	3.0	0.3	1.9	4.9
	On-road	3.0	5.8	3.3	5.5	2.3	3.5	10.2
	Points	7.1	18.0	2.4	10.9	1.1	1.2	3.9
	Subtotal	28.0	39.6	19.6	35.3	18.4	11.9	41.6
	Biogenics	70.0	343.6	292.5	273.6	168.8	312.2	242.7
	Total	97.9	383.2	312.1	308.9	187.2	324.1	284.3
Thursday, August 19	Area	16.2	14.8	13.2	15.9	14.7	5.4	22.6
	Off-road	1.7	1.0	0.6	3.0	0.3	1.9	4.9
	On-road	3.7	5.7	3.3	6.8	2.3	3.5	10.2
	Points	7.1	18.0	2.4	10.9	1.1	1.2	3.9
	Subtotal	28.7	39.6	19.6	36.6	18.4	11.9	41.6
	Biogenics	76.7	377.5	316.4	299.0	184.4	339.1	267.8
	Total	105.4	417.1	336.0	335.6	202.8	351.0	309.4
Friday, August 20	Area	16.2	14.8	13.2	15.9	14.7	5.4	22.6
	Off-road	1.7	1.0	0.6	3.0	0.3	1.9	4.9
	On-road	4.3	6.9	3.8	8.1	2.8	3.5	10.2
	Points	7.1	18.0	2.4	10.9	1.1	1.2	3.9

2007 VOC tons Episode Day	Source	Gregg 48183	Harrison 48203	Rusk 48401	Smith 48423	Upshur 48459	Bossier 22015	Caddo 22017
	Subtotal	29.3	40.7	20.1	37.9	18.9	11.9	41.6
	Biogenics	65.4	313.7	281.7	254.1	152.4	274.5	220.0
	Total	94.7	354.4	301.7	292.0	171.3	286.4	261.6
Saturday, August 21	Area	12.6	12.3	10.9	11.1	13.6	5.4	22.5
	Off-road	2.1	2.0	1.4	4.4	0.5	2.5	7.6
	On-road	3.3	5.7	3.1	6.3	2.3	2.6	7.7
	Points	7.1	18.0	2.4	10.9	1.1	1.2	3.9
	Subtotal	25.2	38.1	17.9	32.7	17.5	11.7	41.6
	Biogenics	61.8	292.0	258.1	242.2	148.3	253.4	202.4
	Total	86.9	330.0	276.0	274.9	165.8	265.2	244.0
Sunday, August 22	Area	10.6	11.1	9.9	8.0	12.8	5.4	22.5
	Off-road	2.1	2.0	1.4	4.3	0.5	2.5	7.4
	On-road	2.5	5.5	2.7	4.6	2.1	2.6	7.7
	Points	7.1	18.0	2.4	10.9	1.1	1.2	3.9
	Subtotal	22.3	36.6	16.4	27.9	16.5	11.7	41.5
	Biogenics	64.2	308.5	263.8	249.2	155.1	263.5	210.7
	Total	86.5	345.1	280.2	277.0	171.6	275.1	252.2
Average Episode Day	Area	14.9	13.9	12.4	14.1	14.2	5.4	22.6
	Off-road	1.8	1.3	0.8	3.4	0.4	2.0	5.7
	On-road	3.4	6.1	3.2	6.3	2.3	3.2	9.5
	Points	7.1	18.0	2.4	10.9	1.1	1.2	3.9
	Subtotal	27.2	39.3	18.9	34.6	18.1	11.9	41.6
	Biogenics	65.0	316.8	271.8	253.9	157.1	279.5	221.1
	Total	92.2	356.1	290.8	288.5	175.1	291.4	262.7

Table 3-21. 2007 CO for East Texas NNA and Shreveport area counties.

2007 CO tons Episode Day	Source	Gregg 48183	Harrison 48203	Rusk 48401	Smith 48423	Upshur 48459	Bossier 22015	Caddo 22017
Friday, August 13	Area	3.9	7.4	8.7	9.0	5.8	3.4	12.3
	Off-road	46.2	10.8	8.3	59.3	5.6	29.3	68.8
	On-road	58.9	99.0	44.3	110.0	32.1	35.4	103.6
	Points	5.2	12.3	5.1	5.1	0.7	1.7	1.6
	Subtotal	114.3	129.5	66.5	183.4	44.2	69.8	186.3
	Biogenics	5.6	29.9	27.1	22.8	14.6	26.6	21.1
	Total	119.8	159.4	93.6	206.1	58.9	96.4	207.4
Saturday, August 14	Area	3.4	6.7	8.1	7.2	5.2	3.3	11.7
	Off-road	68.5	18.1	13.3	83.6	7.3	38.0	105.3
	On-road	49.6	87.0	37.8	92.3	28.4	26.5	77.7
	Points	5.2	12.3	5.1	5.1	0.7	1.7	1.6
	Subtotal	126.6	124.1	64.4	188.2	41.6	69.6	196.3
	Biogenics	5.6	28.8	27.0	22.4	14.7	23.9	19.3
	Total	132.3	152.9	91.4	210.6	56.3	93.5	215.6
Sunday, August 15	Area	2.9	6.0	7.5	5.4	4.7	3.3	11.4
	Off-road	67.6	17.6	13.1	82.5	7.1	37.3	103.8
	On-road	35.2	82.7	32.8	65.7	27.5	26.5	77.7
	Points	5.2	12.3	5.1	5.1	0.7	1.7	1.6
	Subtotal	110.8	118.6	58.4	158.6	40.0	68.9	194.5
	Biogenics	5.0	25.1	23.7	20.5	13.0	20.6	16.8
	Total	115.8	143.7	82.1	179.1	53.0	89.5	211.3
Monday, August 16	Area	3.9	7.4	8.7	9.0	5.8	3.4	12.3
	Off-road	46.2	10.8	8.3	59.3	5.6	29.3	68.8
	On-road	41.1	80.0	38.6	77.0	27.3	35.4	103.6

2007 CO tons Episode Day	Source	Gregg 48183	Harrison 48203	Rusk 48401	Smith 48423	Upshur 48459	Bossier 22015	Caddo 22017
	Points	5.2	12.3	5.1	5.1	0.7	1.7	1.6
	Subtotal	96.4	110.5	60.7	150.3	39.4	69.8	186.3
	Biogenics	5.4	27.2	24.8	21.8	13.9	22.5	18.1
	Total	101.8	137.7	85.4	172.1	53.3	92.2	204.4
Tuesday, August 17	Area	3.9	7.4	8.7	9.0	5.8	3.4	12.3
	Off-road	46.2	10.8	8.3	59.3	5.6	29.3	68.8
	On-road	41.6	78.7	38.6	77.8	27.3	35.4	103.6
	Points	5.2	12.3	5.1	5.1	0.7	1.7	1.6
	Subtotal	96.9	109.1	60.7	151.2	39.4	69.8	186.3
	Biogenics	6.1	31.6	27.3	24.3	16.1	26.5	21.5
	Total	103.0	140.7	88.0	175.4	55.5	96.3	207.8
Wednesday, August 18	Area	3.9	7.4	8.7	9.0	5.8	3.4	12.3
	Off-road	46.2	10.8	8.3	59.3	5.6	29.3	68.8
	On-road	38.2	75.8	38.5	71.4	27.3	35.4	103.6
	Points	5.2	12.3	5.1	5.1	0.7	1.7	1.6
	Subtotal	93.5	106.3	60.6	144.8	39.4	69.8	186.3
	Biogenics	6.6	33.9	30.4	26.5	17.1	29.3	23.1
	Total	100.0	140.2	91.0	171.3	56.5	99.0	209.5
Thursday, August 19	Area	3.9	7.4	8.7	9.0	5.8	3.4	12.3
	Off-road	46.2	10.8	8.3	59.3	5.6	29.3	68.8
	On-road	46.0	75.8	38.5	86.1	27.3	35.4	103.6
	Points	5.2	12.3	5.1	5.1	0.7	1.7	1.6
	Subtotal	101.3	106.3	60.6	159.4	39.4	69.8	186.3
	Biogenics	7.2	37.6	32.7	28.5	18.6	32.5	25.9
	Total	108.5	143.8	93.4	188.0	57.9	102.3	212.2
Friday, August 20	Area	3.9	7.4	8.7	9.0	5.8	3.4	12.3
	Off-road	46.2	10.8	8.3	59.3	5.6	29.3	68.8
	On-road	54.9	93.6	45.7	102.5	33.6	35.4	103.6
	Points	5.2	12.3	5.1	5.1	0.7	1.7	1.6
	Subtotal	110.2	124.1	67.8	175.9	45.7	69.8	186.3
	Biogenics	5.9	30.3	28.5	23.7	14.8	25.8	20.8
	Total	116.1	154.3	96.3	199.6	60.5	95.5	207.1
Saturday, August 21	Area	3.4	6.7	8.1	7.2	5.2	3.3	11.7
	Off-road	68.5	18.1	13.3	83.6	7.3	38.0	105.3
	On-road	45.3	83.2	39.1	84.3	29.6	26.5	77.7
	Points	5.2	12.3	5.1	5.1	0.7	1.7	1.6
	Subtotal	122.4	120.3	65.7	180.2	42.8	69.6	196.3
	Biogenics	5.6	28.2	26.4	22.8	14.5	23.5	19.0
	Total	128.0	148.4	92.1	203.0	57.4	93.1	215.3
Sunday, August 22	Area	2.9	6.0	7.5	5.4	4.7	3.3	11.4
	Off-road	67.6	17.6	13.1	82.5	7.1	37.3	103.8
	On-road	34.0	78.8	34.4	63.5	27.5	26.5	77.7
	Points	5.2	12.3	5.1	5.1	0.7	1.7	1.6
	Subtotal	109.6	114.8	60.0	156.5	40.0	68.9	194.5
	Biogenics	6.0	30.2	27.6	24.3	15.5	24.8	20.2
	Total	115.6	145.0	87.6	180.8	55.5	93.7	214.7
Average Episode Day	Area	3.7	7.1	8.5	8.2	5.6	3.4	12.0
	Off-road	52.5	12.8	9.7	66.1	6.0	31.7	79.1
	On-road	43.7	81.8	38.7	81.6	28.4	32.8	96.2
	Points	5.2	12.3	5.1	5.1	0.7	1.7	1.6
	Subtotal	105.0	114.0	62.0	161.0	40.7	69.6	188.9
	Biogenics	6.0	30.9	27.9	24.2	15.6	26.2	21.0
	Total	111.0	144.9	89.9	185.2	56.3	95.8	209.9

Table 3-22. Tons/day NOx for facilities treated with plume in grid within the 4km domain for 2007 August episode. These represent only the elevated point emissions at each facility.

Facility Name	Data Source	Stack	Weekday	Weekend	Episode Average
Dolet_Hills_Power		1	32.5	29.9	31.8
Dolet_Hills_Power Total	EPA HDD Rulemaking		32.5	29.9	31.8
Knox_Lee		2	0.3	0.3	0.3
		3	0.3	0.3	0.3
		4	2.1	2.1	2.1
		5	3.2	3.2	3.2
Knox_Lee Total	NETx SIP		5.9	5.9	5.9
LG&E		100	0.9	0.9	0.9
		200	0.9	0.9	0.9
		300	0.9	0.9	0.9
		400	0.9	0.9	0.9
		500	0.9	0.9	0.9
		600	0.9	0.9	0.9
LG&E Total	TCEQ		5.1	5.1	5.1
Libbey_Glass		0	2.5	2.5	2.5
Libbey_Glass Total	EPA HDD Rulemaking		2.5	2.5	2.5
Logansport		0	2.6	2.6	2.6
Logansport Total	EPA HDD Rulemaking		2.6	2.6	2.6
Martin_Lake		1	18.5	18.5	18.5
		2	19.8	19.8	19.8
		3	19.2	19.2	19.2
Martin_Lake Total	NETx SIP		57.5	57.5	57.5
Monticello		1	15	15	15.0
		2	14.7	14.7	14.7
		3	18.7	18.7	18.7
Monticello Total	NETx SIP		48.4	48.4	48.4
Pirkey		1	18	18	18.0
Pirkey Total	NETx SIP		18	18	18.0
Stryker_Creek		1	9.4	9.4	9.4
		2	4.7	4.7	4.7
Stryker_Creek Total	NETx SIP		14.1	14.1	14.1
Tenaska		1	1.3	1.3	1.3
		2	1.3	1.3	1.3
		3	1.3	1.3	1.3
Tenaska Total	TCEQ		3.8	3.8	3.8
Welsh		11	10.1	10.1	10.1
		12	9.7	9.7	9.7
		13	9.4	9.4	9.4
Welsh Total	TCEQ		29.2	29.2	29.2
Wilkes		1	1.5	1.5	1.5
		2	2.9	2.9	2.9
		3	2.6	2.6	2.6
Wilkes Total	NETx SIP		7	7	7.0

Note: The August 2007 episode consists of the dates Aug. 13-22. Weekday dates correspond to Aug. 13 and Aug. 16-20. Weekend dates are Aug. 14-15 and Aug. 21-22

Table 3-23. Eastman Chemical Co. total elevated and surface NOx tpd for average August 2007 episode day. The 'other' represents over a hundred individual stacks.

	Cogen Unit Stack 1	Cogen Unit Stack 2	Other Elevated	Other Surface	Total
NOx	1.05	1.05	6.5	1.1	9.7
VOC	0.0	0.0	1.0	11.9	12.9

Note: The cogen unit emissions are not actually Eastman Chemical Co. emissions, but are included in this table because Eastman agreed to offset the cogen emissions as part of their overall NOx reduction commitment.

Table 3-24. 'New' point sources in Northeast Texas. Sources in the 2007 modeling which were not present in the 1999 base year modeling.

Facility Name	County	NOx
Entergy Power Ventures	Harrison	0.9
LG&E Power	Anderson	5.1
Tenaska Gateway	Rusk	3.8

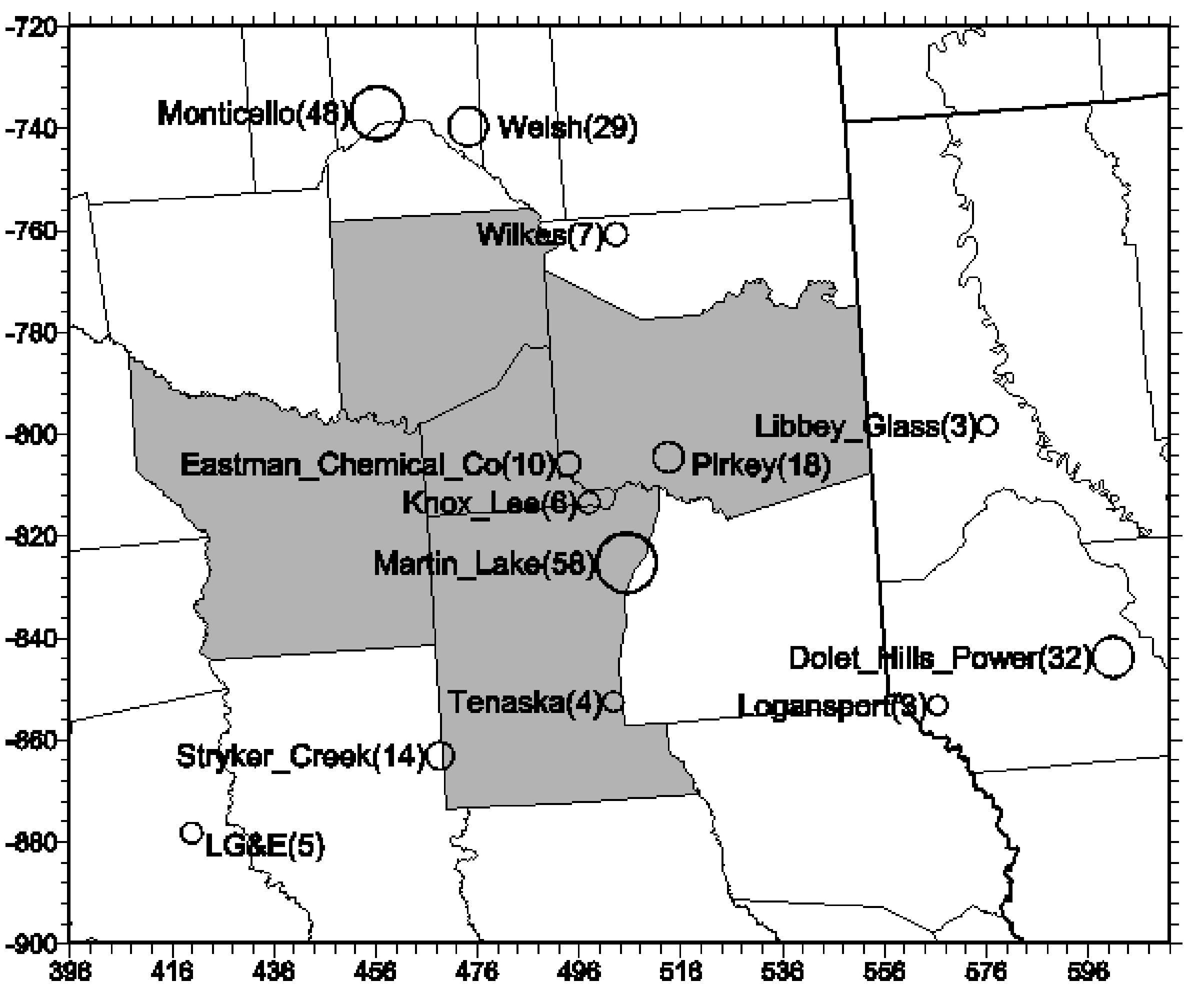


Figure 3-3. 2007 average episode day NOx for the facilities in Table 3-22. These represent elevated sources for all facilities with the exception of Texas Eastman Chemical Co. which represents the total NOx from Table 3-23.

Table 3-25. Texas gridded 2007 episode day emissions by major source type.

Episode Day	Area	Off-road	On-road	EGUs	Other Points	Off-Shore	Ship-ping	Total Anthro-pogenic	Bio-genic	Total
Tons NOx										
Friday, August 13	712	853	837	745	1314	549	40	5050	1100	6150
Saturday, August 14	693	843	623	745	1309	549	40	4802	1082	5884
Sunday, August 15	675	781	501	745	1309	549	40	4601	1105	5706
Monday, August 16	712	853	892	745	1314	549	40	5105	1082	6187
Tuesday, August 17	712	853	898	745	1314	549	40	5111	1040	6151
Wednesday, August 18	712	853	852	745	1314	549	40	5065	1078	6143
Thursday, August 19	712	853	849	745	1314	549	40	5062	1068	6129
Friday, August 20	712	853	860	745	1314	549	40	5073	1052	6125
Saturday, August 21	693	843	629	745	1309	549	40	4808	1053	5861
Sunday, August 22	675	781	490	745	1309	549	40	4589	1010	5599
Tons VOC										
Friday, August 13	1967	377	564	23	673	189	1	3794	22087	25881
Saturday, August 14	1554	704	494	23	644	189	1	3610	20527	24137
Sunday, August 15	1324	696	429	23	644	189	1	3305	20445	23750
Monday, August 16	1967	377	503	23	673	189	1	3732	19998	23730
Tuesday, August 17	1967	377	513	23	673	189	1	3743	19290	23033
Wednesday, August 18	1967	377	448	23	673	189	1	3677	20752	24430
Thursday, August 19	1967	377	447	23	673	189	1	3677	21745	25421
Friday, August 20	1967	377	576	23	673	189	1	3805	20788	24593
Saturday, August 21	1554	704	488	23	644	189	1	3604	19565	23168
Sunday, August 22	1324	696	417	23	644	189	1	3293	18023	21317
Tons CO										
Friday, August 13	1034	6282	7137	208	1073	126	6	15866	2270	18136
Saturday, August 14	889	9210	6486	208	1063	126	6	17988	2159	20146
Sunday, August 15	746	9093	5729	208	1063	126	6	16971	2128	19099
Monday, August 16	1034	6282	6317	208	1073	126	6	15046	2078	17124
Tuesday, August 17	1034	6282	6488	208	1073	126	6	15217	2005	17222
Wednesday, August 18	1034	6282	5791	208	1073	126	6	14520	2136	16656
Thursday, August 19	1034	6282	5658	208	1073	126	6	14386	2212	16599
Friday, August 20	1034	6282	7065	208	1073	126	6	15794	2127	17922
Saturday, August 21	889	9210	6407	208	1063	126	6	17909	2045	19954
Sunday, August 22	746	9093	5717	208	1063	126	6	16960	1963	18923

Table 3-26. Summary of August 2007 gridded emissions by major source type for states other than Texas.

	Area			Off-road			On-road			Point			Anthropogenic		
State	Week day	Sat	Sun	Week day	Sat	Sun	Week day	Sat	Sun	Week day	Sat	Sun	Total Weekday	Total Sat	Total Sun
NOx															
Alabama	163	150	144	209	212	196	316	237	237	457	437	437	1144	1036	1014
Arkansas	128	118	113	145	147	137	193	145	145	237	223	223	703	633	618
Florida	6	5	5	59	67	63	86	64	64	128	122	122	278	259	254
Georgia	58	54	52	197	181	158	475	357	357	255	240	240	985	832	807
Illinois	13	12	12	204	204	197	145	109	109	274	263	263	637	588	581
Indiana	32	30	29	140	134	124	159	119	119	260	242	242	591	525	514
Kansas	242	222	213	326	319	306	173	130	130	553	527	527	1294	1198	1175
Kentucky	259	239	229	252	254	242	304	228	228	357	335	335	1172	1056	1033
Louisiana	355	327	312	633	646	631	263	197	197	1058	1037	1037	2309	2207	2177
Mississippi	157	144	138	168	170	159	220	165	165	429	412	412	974	891	874
Missouri	38	36	34	318	332	312	407	306	306	240	226	226	1004	899	877
Nebraska	4	4	4	46	45	45	12	9	9	45	43	43	107	101	100
North Carolina	1	1	1	4	3	3	13	10	10	7	7	7	25	21	21
Ohio	24	22	21	61	56	49	91	69	69	188	175	175	364	321	313
Oklahoma	103	95	91	158	163	153	269	202	202	647	619	619	1177	1078	1064
South Carolina	0	0	0	0	0	0	3	2	2	0	0	0	3	3	3

	Area			Off-road			On-road			Point			Anthropogenic		
State	Week day	Sat	Sun	Week day	Sat	Sun	Week day	Sat	Sun	Week day	Sat	Sun	Total Weekday	Total Sat	Total Sun
Tennessee	69	65	63	448	449	430	387	290	290	320	307	307	1223	1111	1090
Virginia	1	1	1	3	3	2	6	5	5	0	0	0	10	8	8
West Virginia	3	3	3	42	42	41	10	8	8	52	48	48	107	101	100
Grand Total	1655	1527	1463	3413	3427	3246	3533	2650	2650	5509	5263	5263	14110	12866	12622
VOC															
Alabama	387	387	387	137	311	309	226	169	169	167	167	167	918	1035	1032
Arkansas	350	350	350	82	179	177	119	89	89	35	35	35	587	653	652
Florida	119	119	119	77	191	190	57	43	43	13	13	13	266	365	365
Georgia	476	476	476	149	217	213	291	218	218	78	78	78	995	990	986
Illinois	178	178	178	60	99	98	82	61	61	117	117	117	437	455	454
Indiana	238	238	238	48	80	78	95	71	71	39	39	39	420	427	426
Kansas	365	364	364	77	114	112	106	80	80	40	40	40	588	598	596
Kentucky	378	378	377	94	196	195	181	135	135	180	180	180	832	889	887
Louisiana	323	322	322	153	349	347	159	120	120	242	241	241	876	1032	1030
Mississippi	371	371	371	91	212	210	129	97	97	151	151	151	742	831	829
Missouri	421	421	421	173	383	380	249	187	187	158	157	157	1001	1148	1145
Nebraska	45	45	45	8	11	10	7	5	5	3	3	3	62	63	63
North Carolina	17	17	17	5	10	10	7	5	5	3	3	3	33	36	36
Ohio	131	131	131	37	46	45	59	45	45	29	29	29	256	250	249
Oklahoma	290	290	290	86	176	174	185	139	139	97	96	96	657	700	699
South Carolina	2	2	2	0	0	0	2	1	1	0	0	0	4	3	3
Tennessee	664	664	664	137	280	277	238	178	178	193	193	193	1231	1315	1312
Virginia	8	8	8	1	1	1	4	3	3	1	1	1	13	12	12
West Virginia	15	15	15	6	11	11	6	5	5	7	7	7	34	38	38
Grand Total	4778	4776	4775	1421	2866	2838	2202	1651	1651	1552	1549	1549	9953	10843	10813
CO															
Alabama	181	179	177	1275	2086	2053	2268	1701	1701	613	611	611	4338	4577	4544
Arkansas	100	98	98	865	1409	1388	1290	968	968	330	329	329	2585	2804	2782
Florida	5	5	5	438	830	823	584	438	438	40	40	40	1068	1314	1306
Georgia	171	170	170	2022	2805	2758	3244	2433	2433	230	228	228	5667	5637	5589
Illinois	22	22	22	788	1096	1081	959	719	719	62	61	61	1832	1898	1884
Indiana	40	39	39	817	1097	1076	1081	811	811	265	263	263	2203	2210	2189
Kansas	140	137	135	1208	1634	1608	1197	897	897	241	238	238	2785	2906	2878
Kentucky	175	171	170	1063	1731	1705	1978	1484	1484	235	232	232	3451	3618	3591
Louisiana	117	113	110	1398	2445	2416	1753	1315	1315	2435	2431	2431	5702	6303	6272
Mississippi	128	126	125	749	1252	1231	1246	934	934	363	360	360	2486	2673	2650
Missouri	157	156	156	2450	3802	3758	2735	2051	2051	317	315	315	5658	6324	6280
Nebraska	14	14	14	108	147	145	74	55	55	7	7	7	203	223	222
North Carolina	11	11	11	48	68	67	83	62	62	10	10	10	152	152	151
Ohio	54	54	54	904	1107	1092	637	478	478	100	99	99	1695	1737	1722
Oklahoma	77	75	75	1121	1742	1723	1849	1387	1387	679	674	674	3725	3878	3859
South Carolina	1	1	1	1	1	1	19	15	15	0	0	0	21	16	16
Tennessee	250	248	247	1656	2610	2569	2588	1941	1941	299	298	298	4793	5097	5056
Virginia	5	5	5	13	18	17	38	28	28	0	0	0	56	52	51
West Virginia	5	5	5	60	93	91	71	53	53	13	13	13	149	164	162
Grand Total	1653	1631	1620	16984	25974	25605	23695	17771	17771	6240	6209	6209	48571	51584	51204

Table 3-27. Gridded biogenic emissions for states other than Texas.

	13-Aug	14-Aug	15-Aug	16-Aug	17-Aug	18-Aug	19-Aug	20-Aug	21-Aug	22-Aug
NOx (tpd)										
Alabama	78	68	64	70	74	77	74	68	67	68
Arkansas	128	96	94	109	126	134	129	103	102	112
Florida	11	10	9	9	10	10	10	9	9	9
Georgia	51	49	45	47	47	49	48	44	45	46
Illinois	338	271	282	343	385	334	303	292	299	333
Indiana	158	112	121	145	164	144	128	120	130	141
Kansas	444	497	613	689	645	574	494	472	549	549
Kentucky	154	108	113	139	160	149	143	118	122	134
Louisiana	111	102	91	98	106	112	116	106	101	103
Mississippi	133	108	99	113	127	133	137	116	110	118
Missouri	245	215	242	300	314	294	250	235	250	270
Nebraska	148	176	221	226	211	192	170	175	194	192
North Carolina	2	1	1	1	2	1	2	1	1	1
Ohio	22	17	18	20	25	20	19	17	18	20
Oklahoma	196	195	220	238	232	233	202	187	208	216
South Carolina	0	0	0	0	0	0	0	0	0	0
Tennessee	122	86	87	107	120	122	118	93	94	103
Virginia	1	1	0	1	1	1	1	0	0	1
West Virginia	0	0	0	0	1	0	0	0	0	0
NOX Totals	2342	2112	2322	2656	2750	2581	2342	2158	2301	2415
VOC (tpd)										
Alabama	14097	11687	10261	11937	12969	14092	12878	11027	10796	10584
Arkansas	11291	7772	7543	9151	11323	12454	11394	8109	8074	9278
Florida	2772	2287	2158	2335	2424	2413	2501	2227	2391	2268
Georgia	5614	5244	4760	5001	5229	5973	5539	4163	4471	4451
Illinois	1692	982	1211	1758	1987	1250	1215	1236	1343	1558
Indiana	1395	554	823	1163	1421	999	837	747	910	1067
Kansas	973	1127	1674	2129	1944	1678	1204	1015	1365	1136
Kentucky	3596	1383	1808	2922	3641	2991	2727	1654	2109	2645
Louisiana	9282	8317	6817	7615	8392	8981	9574	8468	7649	7784
Mississippi	14325	10911	9068	11206	12666	13599	13921	11249	10355	11261
Missouri	7786	5601	7350	10521	11716	10253	7380	6513	7538	8222
Nebraska	143	225	345	363	330	276	212	225	266	218
North Carolina	602	497	414	512	568	547	565	367	356	388
Ohio	210	86	113	170	234	163	122	110	133	423
Oklahoma	6505	5351	5630	6046	6717	7195	6392	4891	5089	5953
South Carolina	105	102	83	90	95	111	107	70	72	83
Tennessee	8016	3911	4390	6723	7714	7522	7131	4132	4768	5342
Virginia	98	62	46	91	109	91	82	46	50	71
West Virginia	88	37	38	68	93	66	59	36	47	103
VOC Totals	88590	66134	64531	79801	89572	90652	83840	66284	67781	72836
CO (tpd)										
Alabama	1349	1141	1014	1143	1231	1328	1223	1092	1068	1073
Arkansas	1030	752	705	834	1019	1132	1030	776	764	859
Florida	354	313	282	301	309	313	312	291	300	295
Georgia	517	457	411	433	451	495	474	381	391	401
Illinois	166	108	117	155	180	149	136	123	127	146
Indiana	145	82	93	123	147	118	101	90	101	118
Kansas	136	149	205	257	241	210	155	143	176	173
Kentucky	344	196	194	276	337	288	267	195	212	263
Louisiana	953	882	722	791	872	934	1002	885	810	815
Mississippi	1302	1022	847	1011	1142	1232	1246	1036	959	1037
Missouri	610	470	551	742	842	801	594	524	574	630

	13-Aug	14-Aug	15-Aug	16-Aug	17-Aug	18-Aug	19-Aug	20-Aug	21-Aug	22-Aug
Nebraska	21	27	39	42	39	33	26	27	32	31
North Carolina	54	44	38	45	48	46	49	36	33	37
Ohio	20	12	12	16	21	15	13	11	13	51
Oklahoma	559	472	489	529	574	624	538	435	470	537
South Carolina	10	9	7	8	8	9	9	7	7	8
Tennessee	692	427	419	584	668	650	621	439	440	480
Virginia	9	7	5	8	10	8	8	5	5	7
West Virginia	8	5	4	6	8	6	5	4	4	11
CO Totals	8277	6575	6152	7304	8146	8392	7809	6499	6486	6972

EASTMAN CHEMICAL CO. 1999 VOC SPECIATION PROFILES

VOC profiles were developed for Texas Eastman based on detailed emissions data reported to TCEQ for 1999. The Texas Eastman speciated VOC data were extracted from version 12b of the TCEQ point source database. These data were used to develop 200 point specific speciation profiles. Over 94% of the total Texas Eastman VOCs were speciated according to the reported VOC components. The remaining 6% could not be speciated with the PSDB data because the reported data contained insufficient detail, and so these emissions were speciated using default TCEQ/EPA profiles. Table 3-28 summarizes the tons/day of each VOC component used in the point specific profiles while the corresponding TCEQ identifying FIN and EPN codes are presented in Table 3-29.

Table 3-28. Texas Eastman 1999 VOC emissions (tons/day) by compound for sources with point specific profiles.

VOC Name	Emissions
ethylene	4.53904
propene	0.99026
propane	0.55630
ethyl alcohol	0.41464
ethyl acetate	0.39446
isobutylacetate	0.26186
methylchloride	0.21202
ethane	0.20591
isobutyraldehyde	0.18119
methane	0.15586
ethyl ether	0.15553
n-butyl alcohol	0.12768
formaldehyde	0.12652
n-propyl alcohol	0.09366
mineral spirits	0.09229
butyraldehyde	0.09201
benzene	0.08691
toluene	0.07996
ethers-unspec	0.07981
isobutyl alcohol	0.06949
2-ethylhexanol	0.06916
ethylene glycol	0.06869
n-butane	0.06631
acetaldehyde	0.06524
propionaldehyde	0.06416
maleic anhydride	0.05537
esters,unspec	0.04365

VOC Name	Emissions
aromatics-unspec	0.04029
chloroform	0.03731
hexane	0.03717
isopropyl alcohol	0.03398
alcohols,unspec	0.03308
acetone	0.03293
glycols-unspec	0.03249
ethyl chloride	0.02958
isomers of pentane	0.02860
1,3-butadiene	0.02800
styrene	0.02767
aniline	0.02737
methyl alcohol	0.02567
ethylbenzene	0.02502
isomers of xylene	0.02385
1-hexene	0.02003
aldehydes-unspec	0.01821
acetic acid	0.01688
isobutylisobutyrate	0.01475
ethylhexaldehyde	0.01381
isomers of butene	0.01085
cyclohexane	0.01058
glycol ether	0.00944
propionic acid	0.00933
butene	0.00900
acetylene	0.00883
olefins-unspec	0.00797

VOC Name	Emissions
isobutane	0.00744
heptane	0.00678
methylacrylate	0.00672
acrylonitrile	0.00628
isopentane	0.00609
napthalene	0.00524
methylethyl ketone	0.00426
tetrahydrofuran	0.00355
ethylene oxide	0.00324
isomers of hexane	0.00280
methylisobutyl keto	0.00262
4-methylaniline	0.00213
t-butyl alcohol	0.00210
butylacrylate	0.00190
o-xylene	0.00144
sec-butyl alcohol	0.00131
vinyl acetate	0.00129
crotonaldehyde	0.00074
n-butylacetate	0.00065
carbon tetrachlorid	0.00052
n-propylacetate	0.00040
chlorobenzene	0.00038

VOC Name	Emissions
3-methylpentane	0.00031
hexadiene	0.00028
octane	0.00024
methylcyclopentane	0.00022
formic acid	0.00015
acrylic acid	0.00015
naphtha	0.00015
chlorinated hydrocar	0.00007
cyclopentane	0.00005
methylformate	0.00004
trans-2-butene	0.00003
ethylene dichloride	0.00003
ethylene dibromide	0.00003
methyl acrylic acid	0.00003
n-hexanol	0.00003
ketones-unspec	0.00003
nonane	0.00002
n-pentane	0.00001
ethyl acrylate	0.00001
acetonitrile	0.00001

Table 3-29. Texas Eastman point sources (EPN/FIN) for which facility specific speciation profiles were developed and total VOC emissions by point.

FIN	EPN	Total VOC (tons/day)
EB025T51	025T62	0.00742
EB025T58	025T62	0.01445
EB025WW1	F025WW1	0.01006
EB093FG1	F093FG1	0.00848
EB093T703	093T704	0.04689
EB106FG1	F106FG1	0.00564
EB108FG2	F108FG2	0.06323
EB108KT7	108KT7	0.01713
EB108T521	042FL1	0.02199
EP008FG1	F008FG1	0.56191
EP008FG2	F008FG2	0.12979
EP008T71	008T71	0.00838
EP009T14	116FL2H	0.02048
EP034D203	034D203	0.17016
EP035D203	035D203	0.11751
EP036FG1	F036FG1	0.02194
EP036U1	036U1	0.01343
EP037FG1	F037FG1	0.01840
EP037GA1	037GA1	0.00572
EP037U501	037U501	0.05498
EP038FG1	F038FG1	0.00695
EP038FG2	F038FG2	0.00581
OL007FG1	F007FG1	0.20317
OL007VS1	116FL2H	0.04764
OL014FG2	F014FG2	0.01033
OL014FG3	F014FG3	0.00602
OL032FG1	F032FG1	0.42642

FIN	EPN	Total VOC (tons/day)
OL032GA1	032GA1	0.01572
OL032VS1	233FL1	0.07251
OL033FG1	F033FG1	0.65063
OL033GA1	033GA1	0.01280
OL033VS1	170FL1	0.07484
OL041FG1	F041FG1	0.04594
OL041FG2	F041FG2	0.00776
OL042FL2	042FL2	0.00630
OL043FG1	F043FG1	0.56196
OL043VS1	042FL1	0.06909
OL170FL2	170FL2	0.00772
OL225B1A	225B1A	0.00878
OL225B1B	225B1B	0.00878
OL226FG1	F226FG1	0.91296
OL226VS1	225FL1	0.00570
OL229CT7	F136CT7	0.02262
OL229H1	229H1	0.00515
OL229H2	229H2	0.00515
OL229H3	229H3	0.00515
OL229H4	229H4	0.00515
OL229WW1	229WW1	0.01420
OLF041FG3	F041FG3	0.00665
OX010FG3	F010FG3	0.01034
OX010T220	030B11	0.00563
OX011FG3	F011FG3	0.02355
OX015FG1	F015FG1	0.13892
OX015FG2	F015FG2	0.28606

FIN	EPN	Total VOC (tons/day)
OX015R502	015E508	0.08448
OX015R504	015E550	0.13305
OX015R507	015E569	0.08448
OX015T507	015T507	0.02220
OX015T508	015VS1	0.01798
OX015T524	015VS1	0.01562
OX015T535	015E505	0.01018
OX015T94	015T96	0.00527
OX016FG1	F016FG1	0.02131
OX016FG2	F016FG2	0.02131
OX016FG3	F016FG3	0.01126
OX016T560	016E573	0.01018
OX016VS4	016CU1	0.00616
OX050T422	050T422	0.00577
OX053FG1	F053FG1	0.23133
OX053FG2	F053FG2	0.09875
OX061FG1	F061FG1	0.03071
OX061H1	061CD6	0.00566
OX061H1	061CD7	0.00566
OX061H5	061CD12	0.00575
OX061H5	061CD17	0.01579
OX061H7	061CD14	0.01632
OX061H7	061CD61	0.01632
OX062C16	062C16	0.01287
OX062C17	062C17	0.01284
OX062C19	062C19	0.01297
OX062C20	062C20	0.01273
OX062C22	062C22	0.01642
OX062C7	062C7	0.01204
OX062C9	062C9	0.01073
OX062FG1	F062FG1	0.03317
OX062H11A	062CD18A	0.00839
OX062H11A	062CD18B	0.00839
OX062H11A	062CD18C	0.00839
OX062H11B	062CD18A	0.00839
OX062H11B	062CD18B	0.00839
OX062H11B	062CD18C	0.00839
OX062H13A	062CD26	0.01529
OX062H13A	062CD28	0.01529
OX062H13B	062CD26	0.01529
OX062H13B	062CD28	0.01529
OX062H17	062CD32	0.02950
OXF010FG2	F010FG2	0.08329
OXO10FG1	F010FG1	0.07762
PE012C1C	012C1CE	0.00509
PE012DM4B5	012DM4B5	0.00827
PE012FG1	F012FG1	0.17988
PE012FG4	F012FG4	0.39147
PE012FG5	F012FG5	0.47169
PE012FG6	F012FG6	0.01997
PE012FG8	063CU1	0.00877
PE012FG8	F012FG8	0.19044
PE012P12BD	012P12BD	0.00821
PE012S34G	012S34G	0.01643
PE012S34P	012S34P	0.00821
PE012S34R	012S34R	0.00822
PE012S34Y	012S34Y	0.00821
PE012S78	012S78	0.03603
PE012S79	012S79	0.03603
PE012S80	116FL2H	0.01576
PE012STD	012STD	0.01216
PE012STE	012STE	0.00520
PE013C1F	013C1FE	0.00737
PE013C1G	013C1GE	0.01002
PE013C7A	013C7AE	0.01248
PE013C7B	013C7BE	0.01248
PE013D310	013D310	0.01140
PE013D311	013D311	0.01140
PE013D312	013D312	0.01140
PE013D313	013D313	0.01140
PE013D340	013D340	0.01842
PE013D341	013D341	0.01842
PE013D342	013D342	0.01842
PE013D343	013D343	0.01842
PE013D344	013D344	0.01842
PE013D345	013D345	0.01842
PE013DM4B6	013DM4B6	0.00827
PE013DM4B7	013DM4B7	0.03033
PE013DMR1	013DMR1	0.01745
PE013FG1	F013FG1	0.43451
PE013S34H	013S34H	0.00821
PE063C5A	063C5AE	0.00908
PE063C5B	063C5BE	0.00908
PE065D614	065D614	0.00777
PE065D615	065D615	0.00777
PE065D616	065D616	0.00777
PE065D617	065D617	0.00777
PE065D618	065D618	0.00777
PE066FG1	F066FG1	0.08703
PE066FG2	F066FG2	0.02397
PE066FG3	F066FG3	0.01744
PE137VS1	137VS1	0.08770
PE143FG1	F143FG1	0.17180
PE146FG1	F146FG1	0.00776
PE224T01	224T01	0.00733
PE224VS1	145FL1	0.01083
PE252EX1	F045CT5	0.00797
PE252F710	252BH710	0.00571
PE252FG1	F252FG1	0.07270
PE252VS1	085FL1	0.02619
PE256FG1	F256FG1	0.01005
PP028FG1	F028FG1	0.16774
PP028T331	054FL2	0.00897
PP028VS1	054FL2	0.00749
PP054FL2	054FL2	0.01716
RD005AV2	F005AV2	0.00659
RD005FG6	F005FG6	0.12189
RD005FG7	F005FG7	0.02959
RD005S3425	128FL1	0.00773
RD059FG1	F059FG1	0.01389
RDF066FG4	F066FG4	0.00938
SD008LR1	008LR1	0.02006

FIN	EPN	Total VOC (tons/day)
SD015LR1	015LR1	0.01895
SD015LT76	015LT76	0.00588
SD020FG1	F020FG1	0.04346
SD020T100	020T100	0.00500
SD020T112	020T112	0.00770
SD020T115	020T115	0.00554
SD021T131	021T131	0.00554
SD027FG1	F027FG1	0.01298
SD049FG1	F049FG1	0.02169
SD049T200	049T200	0.00614
SD049T201	049T201	0.00614
SD049T202	049T202	0.04835
SD051FG1	F051FG1	0.06692
SD093T9	093T9	0.00665
SD098FG1	F098FG1	0.02888
SD103LR1	170FL1	0.01224
SD205LR1	225FL1	0.00801

FIN	EPN	Total VOC (tons/day)
SD269FG1	F269FG1	0.04268
SD269GA1	269GA1	0.00960
UD009CT1	F009CT1	0.00705
UD010CT6	F010CT6	0.00535
UD030B11	030B11	0.00763
UD030B12	030B12	0.00794
UD030FG1	F030FG1	0.00580
UD040CT2	F040CT2	0.04997
UD042CT4	F042CT4	0.02006
UD045CT5	F045CT5	0.02266
UD047B13	047B13	0.01570
UD047B14	047B14	0.01570
UD063CT3	F063CT3	0.02178
UD136CT7	F136CT7	0.01011
UD187FG1	F187FG1	0.01040
UD239T4	239T4	0.01499
UD633SB1	F633SB1	0.00608

EASTMAN CHEMICAL CO. 2002 VOC SPECIATION PROFILES

Using data from Eastman Chemical Co. 2002, 740 profiles were developed for specific point sources – this accounted for 79% of the total Eastman VOC emissions. From the original Eastman emission data, certain categories (such as “alcohols-u”, “aldehydes-u”, etc.) were substituted with representative fractions of similar components (for example, “alcohols-u” was substituted with “ethanol”, “methanol”, “isopropynol”, etc). The amounts of these substituted species were determined by using average percentages obtained from the entire group of point sources. Certain categories (such as nonmethane VOC’s) could not be speciated with more detail, and thus were lumped together into an “Other” category. Then, for point sources which contained less than 15% “Other”, the amount of “Other” was ignored, the data was renormalized and a weight fraction profile was developed. This was used to create a speciation profile for the point source for use in modeling.

Table 3-30 summarizes the tons/day of each VOC component used in the point specific profiles while the corresponding TCEQ identifying FIN and EPN codes are presented in Table 3-31.

Table 3-32 summarizes emissions (tons/day) by compound for sources without point specific profiles while the corresponding TCEQ identifying FIN and EPN codes are presented in Table 3-33.

Table 3-30. Eastman Chemical Co. 2002 VOC emissions (tons/day) by compound for sources with point specific profiles.

VOC Name	Emissions
ethylene	4.56891
propylene	0.90384
propane	0.68336
ethylene glycol	0.48873
ethyl acetate	0.39370
isobutyl acetate	0.22827
isobutanol	0.17383
methyl chloride	0.16657
ethanol	0.12377
isobutyraldehyde	0.11756
n-propanol	0.10544
n-butyl alcohol	0.10197
glycol ethers(cellosol)	0.10091
acetaldehyde	0.07913
propionaldehyde	0.07263
chloroform	0.06775
benzene	0.06705
butadiene	0.05812
butyraldehyde	0.05777
n butane	0.05003
toluene	0.04994
isobutyric acid	0.04905
ethanolamine	0.04379
isopropanol	0.03894
methanol	0.03468
ethylene oxide	0.03114
esters-u	0.02598
cyclohexane	0.02190
xylene-u	0.02041
ethyl chloride	0.01860
methyl isopropyl ketone	0.01834
ethyl benzene	0.01754
diethylene glycol	0.01735
isobutyl isobutyrate	0.01698
propionic acid	0.01696
butene (1)	0.01429
isobutylene	0.01422
ethyl hexanol (2)	0.01384
hexene	0.01278
methylcyclohexane	0.01223
styrene	0.01182
butene	0.01164
acetic acid	0.01026
naphthalene	0.00996
propyl acetate	0.00815
hexane	0.00787
pentane	0.00779
pentene (1)	0.00765
methyl acrylate	0.00714
formaldehyde	0.00699

VOC Name	Emissions
isopropyl formate	0.00618
ethylhexaldehyde (dot)	0.00601
trimethylcyclohexan	0.00588
n-undecane	0.00580
naphtha	0.00568
decane	0.00559
maleic anhydride	0.00540
octane	0.00487
isobutyronitrile	0.00473
methyl isobutyl ketone	0.00457
trans-2-butene	0.00448
diethyl ether	0.00406
tetrahydrofuran	0.00364
dimethylhexene	0.00323
2,6-dimethyloctane	0.00306
isopropyl acetate	0.00306
butyl acrylate	0.00288
2-methylheptane	0.00283
butoxyethanol (2)	0.00279
dimethylcyclopentan	0.00271
heptane	0.00262
dimethylcyclohexane	0.00248
butyronitrile	0.00240
trimethylcyclopenta	0.00201
butene (cis-2-)	0.00187
3-methylheptane	0.00178
2-methylhexane	0.00166
nonane	0.00151
ethylpropylcyclohex	0.00142
ethylcyclohexane	0.00131
butyl acetate	0.00127
c4 cyclohexane	0.00125
isobutane	0.00119
proproxyethanol (2)	0.00116
methylpropylcyclohe	0.00106
dimethylheptanes	0.00097
cellosolve solvent	0.00090
4-methylheptane	0.00078
indene	0.00077
butylcyclohexane	0.00075
n-dodecane	0.00074
ethylcyclopentane	0.00073
ethyldimethyloctane	0.00072
trimethyl benzene, 1,3,5-	0.00071
benzyl alcohol	0.00069
heptanone (2)	0.00065
2,3-dimethyloctane	0.00063
2,4-dimethylhexane	0.00059
4-methyloctane	0.00058
2,5-dimethylheptane	0.00057

VOC Name	Emissions
c3 cyclohexane	0.00057
propylcyclohexane	0.00056
3-methyloctane	0.00051
methoxy-2-acetoxypropane, 1-	0.00049
methyl ethyl ketone	0.00042
2,3-dimethylhexane	0.00042
cyclopentylcyclopen	0.00042
ethylhexane	0.00041
2-methyloctane	0.00040
isopropylcyclohexan	0.00037
acetic anhydride	0.00035
diethylcyclohexane	0.00031
2,4-dimethylheptane	0.00030
pentylcyclohexane	0.00027
2,3-dimethylpentane	0.00022
cis-1,4-dimethylcyc	0.00021
triethanolamine	0.00019
3-methylhexane	0.00019
2,2,5-trimethylhexa	0.00015
carbitol cellosolve	0.00015
butyl carbitol	0.00015
n butyl chloride	0.00014
3,4-dimethyloctane	0.00014
2,3,4-trimethylpent	0.00012
2,4-dimethylpentane	0.00010
para-xylene	0.00007
meta-xylene	0.00007
n-tridecane	0.00007
octahydropentalene	0.00006
ortho-xylene	0.00006
ethyl hexanoic acid,2-	0.00006
iso pentane	0.00006
crotonaldehyde	0.00005
isohexane	0.00005
dimethyl sulfide	0.00004
2,5-dimethylhexane	0.00004
2,3-dimethylheptane	0.00004
ethylmethylcyclopen	0.00002
iso-butene	0.00001
methylcyclopentane	0.00001
2,4-dimethyloctane	0.00001
propylene glycol	0.00001
isoheptane	0.000005
triethylene glycol	0.000002

VOC Name	Emissions
2-methyldecane	0.00652

VOC Name	Emissions
ethylmethylcyclohex	0.00057

VOC Name	Emissions

Table 3-31. Eastman Chemical Co. point sources (EPN/FIN) for which facility specific speciation profiles were developed and total VOC emissions by point - (181 out of 740 sources listed, these contribute 98% of the emissions for the entire group).

FIN	EPN	Total VOC (tons/day)
OL226FG1	F226FG1	1.286880548
OL032FG1	F032FG1	0.772957808
OL033FG1	F033FG1	0.745787945
OL043FG1	F043FG1	0.557879178
PE013FG3	F013FG3	0.407310411
PE013FG1	F013FG1	0.385220548
PE012FG4	F012FG4	0.336139726
EP037U501	037U501	0.317808219
OX015FG2	F015FG2	0.315780822
OL007FG1	F007FG1	0.240781918
EP035D203	035D203	0.22162
OX010FG3	F010FG3	0.204381096
PE012FG8	F012FG8	0.190936438
PE143FG1	F143FG1	0.17430137
PE012FG1	F012FG1	0.153418904
RD005FG6	F005FG6	0.150153151
OX015R504	015E550	0.133452055
SD052LR1	052LR1	0.133352329
OX015FG1	F015FG1	0.120164384
EP036U1	036U1	0.11918
SD051FG2	F051FG2	0.094383288
PP028FG1	F028FG1	0.092699452
PE137VS1	137VS1	0.090027397
OX015R502	015E508	0.084712329
OX015R507	015E569	0.084712329
OX010FG1	F010FG1	0.084565753
OX053FG2	F053FG2	0.073227945
OL014FG1	F014FG1	0.054878356
EB025FG1	F025FG1	0.04899
SD049T202	049T202	0.04760411
SD269FG1	F269FG1	0.042795616
SD020FG1	F020FG1	0.042264658
EP038D605	038D605	0.032849315
PE013DM4B7	013DM4B7	0.029392055
OX026T303	F053FG1	0.029369863
PP054FG1	F054FG1	0.02888411
EP034FG1	F034FG1	0.02793
PE012S78	012S78	0.026361918
PE013S79	013S79	0.026361918
SD236LR2	225FL1	0.025211781
UD031T35	031T35	0.024830685
OL032VS1	233FL1	0.02480411
EP034D203	034D203	0.02304
SD008SP45	008LT45	0.023021644
SD049FG1	F049FG1	0.022164384
OL042FL2	042FL2	0.020353151
PE012FG6	F012FG6	0.020075616
OX015T524	015VS1	0.019608219
OX016FG1	F016FG1	0.019506849
PE013D341	013D341	0.01735863
PE013D342	013D342	0.01735863
PE013D343	013D343	0.01735863
PE013D344	013D344	0.01735863
PE013D345	013D345	0.01735863
SD015LR1	015LR1	0.01729589
PE012S34Y	012S34Y	0.016465753
EP036D4	036D4	0.01545
EB025T51	025T62	0.01542
PE252VS2	146FL2	0.015176438
OX016S300	016CU2	0.013673973
EP008FG1	F008FG1	0.01334
PE013DMR1	013DMR1	0.013103014
SD027FG1	F027FG1	0.01301726
SD103LR2	170FL1	0.012814247
RD005FG13	005FG13	0.012485205
UD119TK2	119TK2	0.011464384
UD119TK3	119TK3	0.011464384
UD063CT3	F063CT3	0.011426301
SD205LR1	225FL1	0.011350137
OX016FG3	F016FG3	0.011287671
OL014FG2	F014FG2	0.010909589
SD236LR1	225FL1	0.010906027
OL033GA1	033GA1	0.010707671
EP037GP504	037T621	0.010328767
PE012FG9	F012FG9	0.010242192
SD103LR1	170FL1	0.010161096
SD269GA1	269GA1	0.009852329
PE013D340	013D340	0.009643836
PE012DM4B5	012DM4B5	0.00924411
PE013DM4B6	013DM4B6	0.00924411
OX053FG7	F053FG7	0.0084
EP038FG1	F038FG1	0.008352603
EP038FG2	F038FG2	0.008352329
PE012S34R	012S34R	0.008246027

FIN	EPN	Total VOC (tons/day)
OL033VS1	170FL1	0.02480411
OL043VS1	042FL1	0.02480411
PE066FG2	F066FG2	0.024480822
PE012S34P	012S34P	0.008232603
PE146FG1	F146FG1	0.008046575
PE012FG8	063CU1	0.00723863
RD005DC37	128FL1	0.007166849
SD008LR1	008LR1	0.006985479
EP104T161	141FL1	0.006686027
PE012FG1	063CU1	0.006629863
RD005AV2	F005AV2	0.006602192
UD030FG1	F030FG1	0.006556712
SD093T9	093T9	0.006336164
PE012S80	116FL2H	0.006328219
EP037GA1	037GA1	0.00630137
PP054FL2	054FL2	0.005845753
OX050T422	050T422	0.005784384
OX010T220	030B11	0.005627671
OX098FG13	F098FG13	0.005534247
PE012Y12BD	012Y12BD	0.005488767
OX062H17	062CD32	0.005353425
OX015T94	015T96	0.005306849
OL102FG2	F102FG2	0.00508
SD020T115	020T115	0.005070137
SD021T131	021T131	0.005070137
SD023T139	023T139	0.005017534
SD015LR2	015LR1	0.005009589
SD020T100	020T100	0.004984932
SD049T200	049T200	0.004951781
SD049T201	049T201	0.004951781
UD042CT4	F042CT4	0.004734247
SD048FG1	F048FG1	0.004670959
OX016VS5	016CU1	0.004646575
EP036GA1	036GA1	0.00433
SD015LT76	015LT76	0.00430274
PE012STF	012STF	0.004244384
OX016VS4	016CU1	0.004136986
PE012CTV1	012CTV1	0.004090411
PE012CTV2	012CTV2	0.004090411
EP039T614	039T614	0.004083014
PE013D321	013D321	0.004047671
PE013D322	013D322	0.004047671
PE013D323	013D323	0.004047671
SD020T118	020T118	0.003997808
OX015T44	015T44	0.003980822
OX016T81	016T83	0.003980822
EB093T702	093T702	0.00392
OX053T22	030B11	0.003912055
OX053T6	030B11	0.003912055

FIN	EPN	Total VOC (tons/day)
PE012S34G	012S34G	0.008245479
PE012P12BD	012P12BD	0.008233151
PE013S34H	013S34H	0.008232877
PE012STC	012STC	0.003598082
PE013CTV2	013CTV2	0.003579726
SD093LR1	093LR1	0.003545479
PE013S42H2	013S42H2	0.003526849
EP037VS1	037VS1	0.00348
PE224VS1	145FL1	0.003436164
OX022T123	022T123	0.003387945
OX016D17RW	016D17RW	0.003369863
SD022T114	022T114	0.003336164
EP038D101	038E107	0.003288219
RD005FG10	F005FG10	0.003106849
SD008SP1	008LR1	0.003027671
PE143VE1	145FL1	0.003013699
PE065D615	065D615	0.002968767
PE065D617	065D617	0.002968767
PE065D618	065D618	0.002968767
PE065D616	065D616	0.002948493
OX062H13A	062CD26	0.002843836
OX062H13A	062CD28	0.002843836
OX062H13B	062CD26	0.002843836
OX062H13B	062CD28	0.002843836
PE013STG	013STG	0.002746027
PE012YC3BD	012YC3BD	0.002745753
PE013D311	013D311	0.002655616
PE013D312	013D312	0.002655616
PE013D313	013D313	0.002655616
PE012NBF	012NBF	0.002652877
PP028T331	054FL2	0.002586849
PE012D90	012D90	0.002579452
PE012D91	012D91	0.002579452
PE012D92	012D92	0.002579452
OX061H7	061CD14	0.002575342
OX061H7	061CD61	0.002575342
OX015T508	015VS1	0.002513699
OL041VS1	041FL1	0.002480274
PE013D301	013D301	0.002412329
PE013D302	013D302	0.002412329
PE013D303	013D303	0.002412329
SD100T33	100T33	0.00227863
SD015SP76	015LT76	0.002094247
PE066D204	066D204	0.002070411
SD101T26	101T26	0.002022192
OL014GA1	014GA1	0.003720822
OX053T9	030B11	0.003665479

FIN	EPN	Total VOC (tons/day)
SD020T112	020T112	0.003741918

FIN	EPN	Total VOC (tons/day)

Table 3-32. Eastman Chemical Co. 2002 VOC emissions (tons/day) by compound for sources without point specific profiles.

VOC Name	Emissions
nonmethane voc-u	1.55240
ethylene	0.16034
butyraldehyde	0.06760
propylene	0.06583
hexane	0.04682
isobutyraldehyde	0.04217
gasoline	0.03555
toluene	0.03466
xylene-u	0.03178
ethyl hexanol (2)	0.03106
benzene	0.02941
propionaldehyde	0.02876
propane	0.02774
isobutanol	0.02273
isobutyric acid	0.01806
naphthalene	0.01790
ethyl-3-propyl acrolein, 2-	0.01672
n-butyl alcohol	0.01584
hexene	0.01551
methyl isopropyl ketone	0.01512
isobutyl acetate	0.01291
styrene	0.00759
ethylene oxide	0.00756
ethyl benzene	0.00737
ethyl acetate	0.00731
isobutyronitrile	0.00666
pentane	0.00656
hydrocarbons	0.00644
n-propanol	0.00637
ethylhexaldehyde (dot)	0.00607
chloroform	0.00568
butyric acid	0.00555
parafin wax fumes	0.00351
methyl ethyl ketone	0.00337
butyronitrile	0.00301
ethylene glycol	0.00293
acetic acid	0.00281
glycol ethers(cellosol)	0.00258
distillate	0.00255
ethyl-3-ethoxypropionate	0.00242
acetaldehyde	0.00227
nitriles	0.00225
heptanone (2)	0.00197
heptane	0.00194
isopropanol	0.00169
isopropyl acetate	0.00162
methyl chloride	0.00151
methoxy-2-acetoxypropane, 1-	0.00151

VOC Name	Emissions
dicyclopentadiene	0.001323836
cyclopentadiene	0.001205479
ethyl chloride	0.001028379
benzyl alcohol	9.47840E-04
butyl acetate	8.67397E-04
2-methyldecane	7.00317E-04
lubricating oil	6.83836E-04
n butyl chloride	6.70941E-04
propionic acid	6.57808E-04
trimethylcyclohexan	6.26964E-04
n-undecane	6.18660E-04
butyl cellosolve acetate	6.15890E-04
trimethyl(2.2,4)pentadiol(1,1,3)	6.06413E-04
propyl acetate	6.02740E-04
decane	6.00668E-04
formic acid	5.75890E-04
octane	5.34234E-04
indene	4.72159E-04
methyl isobutyl ketone	4.63533E-04
n butane	4.51507E-04
dimethylhexene	3.40471E-04
2,6-dimethyloctane	3.28014E-04
trimethyl benzene, 1,3,5-	3.13497E-04
2-methylheptane	3.01718E-04
dimethylcyclopentan	2.90646E-04
diethyl ether	2.78082E-04
fuel oil-u	2.73973E-04
dimethylcyclohexane	2.68501E-04
diethylene glycol	2.35049E-04
trimethylcyclopenta	2.15908E-04
formaldehyde	1.95890E-04
3-methylheptane	1.90996E-04
pentene (1)	1.87671E-04
maleic anhydride	1.87123E-04
2-methylhexane	1.78539E-04
methanol	1.69603E-04
butadiene	1.64932E-04
nonane	1.61931E-04
diesel	1.60822E-04
ethylpropylcyclohex	1.52243E-04
butene (1)	1.45753E-04
ethylcyclohexane	1.39787E-04
c4 cyclohexane	1.34251E-04
trans-2-butene	1.21370E-04
isobutane	1.17808E-04
methylpropylcyclohe	1.13490E-04
dimethylheptanes	1.05186E-04
isopropyl formate	8.87671E-05

VOC Name	Emissions
ethylcyclopentane	7.75055E-05
ethyldimethyloctane	7.75055E-05
iso-butene	7.28767E-05
butene (cis-2-)	6.79452E-05
2,3-dimethyloctane	6.78173E-05
2,4-dimethylhexane	6.22812E-05
4-methyloctane	6.22812E-05
2,5-dimethylheptane	6.08972E-05
ethylmethylcyclohex	6.08972E-05
c3 cyclohexane	6.08972E-05
propylcyclohexane	5.95131E-05
3-methyloctane	5.53611E-05
methyl acrylate	4.43836E-05
2,3-dimethylhexane	4.42888E-05
cyclopentylcyclopen	4.42888E-05
ethylhexane	4.42888E-05
2-methyloctane	4.29048E-05
isopropylcyclohexan	4.01368E-05
para-xylene	3.73771E-05
meta-xylene	3.62445E-05
diethylcyclohexane	3.32166E-05
2,4-dimethylheptane	3.18326E-05
ortho-xylene	3.11476E-05
pentylcyclohexane	2.90646E-05
kerosene	2.73973E-05
butyl acrylate	2.46575E-05
cyclohexane	2.46102E-05
acetylene	2.43836E-05
2,3-dimethylpentane	2.35285E-05
cis-1,4-dimethylcyc	2.21444E-05
3-methylhexane	2.07604E-05
diisobutyl ketone	1.70580E-05
2,2,5-trimethylhexane	1.66083E-05
3,4-dimethyloctane	1.52243E-05
2,3,4-trimethylpentane	1.24562E-05
isobutyl isobutyrate	1.23288E-05
2,4-dimethylpentane	1.10722E-05
n-tridecane	6.92013E-06
octahydropentalene	6.92013E-06
2,3-dimethylheptane	4.15208E-06
2,5-dimethylhexane	4.15208E-06
ethylmethylcyclopen	2.76805E-06
2,4-dimethyloctane	1.38403E-06
methylcyclopentane	1.38403E-06
naptha,coal-tar	8.21918E-07
crotonaldehyde	5.47945E-07
no 2 fuel oil	5.47945E-07
butoxyethanol (2)	4.25374E-07

VOC Name	Emissions
ethanol	0.00136
chloroacetaldehyde	0.00136
methylcyclohexane	0.00136

VOC Name	Emissions
4-methylheptane	8.30416E-05
butylcyclohexane	8.02735E-05
n-dodecane	7.88895E-05

VOC Name	Emissions
methyl propyl ketone	3.04957E-07
proproxyethanol (2)	1.98354E-07
propylene glycol	1.44147E-07
triethylene glycol	2.62085E-08

Table 3-33. Eastman Chemical Co. point sources (EPN/FIN) without facility specific speciation profiles, and total VOC emissions by point - (196 out of 442 sources listed, 99% of emissions for entire group).

FIN	EPN	Total VOC (tons/day)
OX053FG1	F053FG1	0.195315068
EB108FG2	F108FG2	0.138027397
PE252VS1	085FL1	0.13660274
UD136CT7	F136CT7	0.132773151
UD010CT6	F010CT6	0.126880548
EP037FG1	F037FG1	0.094098082
UD239T4	239T4	0.085347945
PE252FG1	F252FG1	0.074794521
OX011SB2	011FL1	0.073589041
PE066FG1	F066FG1	0.072674795
OXF010FG2	F010FG2	0.05763
EB093T703	093T704	0.049812329
PE256FG2	F256FG2	0.030328767
OX011FG3	F011FG3	0.029616438
OX062FG1	F062FG1	0.023260274
UD633FG11	F633FG11	0.02304
EB041VT1	041VT1	0.021372603
PE066FG3	F066FG3	0.021299452
UD040CT2	F040CT2	0.020128219
PE013C7A	013C7AE	0.01956
PE013C7B	013C7BE	0.019562466
OL108AS2	108AS2	0.019120822
SD098FG1	F098FG1	0.018739726
EP036FG1	F036FG1	0.018069863
RD059FG1	F059FG1	0.018068767
PE013C1G	013C1GE	0.017515342
EB025T58	025T62	0.017330685
UD239T2	239T2	0.016815068
OL007VS1	116FL2H	0.01672
EB108KT7	108KT7	0.016438356
EB106FG1	F106FG1	0.015671233
OX011FGW	F011FGW	0.015479452
OL031AS1	031AS1	0.014615068
PE063C5A	063C5AE	0.014227397
PE063C5B	063C5BE	0.014227397
OL229WW1	229WW1	0.014039726
SM130FG1	F130FG1	0.01379
SM260FG2	F260FG2	0.013779452
OL041FG1	F041FG1	0.013772603
OL032GA1	032GA1	0.013706575
PE013C1F	013C1FE	0.012893425
OX015T535	015E505	0.012771507
OL229H1	229H1	0.009835342
OX048FG1	F048FG1	0.009616438
EB108T521	042FL1	0.00939726
OL229H4	229H4	0.009382466
OL229H3	229H3	0.009188219
PE012C1C	012C1CE	0.008887671
OL229H2	229H2	0.008476438
OL041FG2	F041FG2	0.007945753
PE013C1D	013C1DE	0.007934521
PE013C1E	013C1EE	0.007934521
UD119T7	119TK1	0.007770137
UD119TK1	119TK1	0.00777
SM633FG13	F633FG13	0.007736438
EB025WW1	F025WW1	0.007702466
SD008VT1	008VT1	0.007340548
PE013C2C	013C2CE	0.007141096
PE013C2D	013C2DE	0.007141096
UD045CT5	F045CT5	0.00712274
OL226T914	226T914	0.007004932
OL229H5	229H5	0.006858904
OL033H5A	033H5A	0.00674
RDF066FG4	F066FG4	0.006665479
OL032H5B	032H5B	0.006625753
OL229H6	229H6	0.006535342
PE224T01	224T01	0.006493151
OL044H5B	044H5B	0.006405753
OL032H5A	032H5A	0.006392877
UD030B12	030B12	0.006109863
PE012C2B	012C2BE	0.005931507
OL044H5A	044H5A	0.00580
OL225B1A	225B1A	0.005435342
PE252F710	252BH710	0.005427671
OL033VT80	033VT80	0.005394521
UD030B11	030B11	0.00536
OX062C9	062C9	0.005308767
UD633FG6	F633FG6	0.005292055
UD030B11	F030FG1	0.005262192
PE013C2E	013C2EE	0.00526
PE013C2F	013C2FE	0.005257534
SD051FG1	F051FG1	0.00509863
OL033H5B	033H5B	0.005092329
HR219FG3	F219FG3	0.005013699

FIN	EPN	Total VOC (tons/day)
OX016T560	016E573	0.012771507
OX062C7	062C7	0.012345205
OL033VT110	033VT110	0.012107671
UD187FG1	F187FG1	0.01154
EB093FG1	F093FG1	0.011228219
OX048T166A	048T166A	0.010523288
PE013VT	013VT	0.01015589
PE012C2A	012C2AE	0.00436411
EB041R3	170FL1	0.004356164
EB041R3	233FL1	0.004356164
OL044H1E	044H5A	0.004276986
OL033H1A	033H5B	0.004270685
OLF041FG3	F041FG3	0.004226027
OL044H1A	044H5B	0.004212329
OL044H1B	044H5B	0.004167123
OL032H1E	032H5A	0.003998904
OL033H1E	033H5A	0.003940548
OL032H1B	032H5B	0.003882466
OL032H2	032H5A	0.003850137
OL033H2	033H5A	0.00379
HR221TG4	221TG4	0.00378
HR221TG5	221TG5	0.00378
HR221TG6	221TG6	0.00378
HR221TG7	221TG7	0.00378
SD006TG2	006TG2	0.00378
SM130TG2	130TG2	0.00378
SM142TG1	142TG1	0.00378
SM266TG3	266TG3	0.00378
SM266TG4	266TG4	0.00378
OL044H2	044H5A	0.00374
UD119S1A/B	119T7	0.00369863
OL044H1D	044H5A	0.003694795
OL032H1A	032H5B	0.003675342
OL032H1D	032H5A	0.003616986
OL044H1C	044H5B	0.003539452
OL032H1C	032H5B	0.003325753
UD119S1A/B	119AS1	0.003222192
OX062C22	062C22	0.00316
UD030B9	030B9	0.003112055
OL044VT80	044VT80	0.00302137
OL033H1D	033H5A	0.002946575
UD030B8	030B8	0.002939452
EP035FG2	F035FG2	0.002841096
OL033H1F	033H1F	0.002840548
EC633FG4	F633FG4	0.002739726
OL226VS1	225FL1	0.00265
EP035R701	035S703	0.002520548
OX062C17	062C17	0.002509589
SD265T1007	265T1007	0.002369863

FIN	EPN	Total VOC (tons/day)
SD102FG3	F102FG3	0.004767123
OL032VT80	032VT80	0.004763288
OL225B1B	225B1B	0.004529315
OL033H1C	033H5B	0.004510137
OL033H1B	033H5B	0.00440
PE012C1A	012C1AE	0.004364384
PE012C1B	012C1BE	0.004364384
SD052WW1	F052WW1	0.002157534
EP035TSCP	035TSCP	0.002016438
EP034TSCP	034TSCP	0.002016164
OL225T910	225T910	0.001965479
EB041T33	170FL1	0.001862192
EB041T33	233FL1	0.001862192
SD052LT6	052LT6	0.001826575
UD633FG9	F633FG9	0.00176411
UD187ES1	187ES1	0.001761644
OL108PC1	108PC1	0.001643836
OXF053FG7	F053FG7	0.001643836
OL007GA1	007GA1	0.001605205
EB108VT1	108VT1	0.001572603
OL007AS1	007AS1	0.00156
SD006FS1	006FS1	0.001554795
EB065T76	065T76	0.001460548
OL226T257	226T257	0.001458082
PE252AV1	F252AV1	0.001408219
OX049T203	049T203	0.001380822
UD119TK6	119T7	0.001326849
OL007VS1	116FL1H	0.001282192
UD119TK4	119T7	0.001212329
UD047B13	047B13	0.00121
OL226T202	226T202	0.001169041
UD047B14	047B14	0.001153699
OL116FL1H	116FL1H	0.001111507
OL032DCA	032DCA	0.00109589
OL033DCA	033DCA	0.00109589
OL044DCA	044DCA	0.00109589
OX011SB2	011SB2	0.001087671
UD223ES1	223ES1	0.001071781
EB093T705	093T705	0.00104
EP035TLCP	035TLCP	0.001021918
PE252UP1	252UP1	0.000991781
OL231PC2	231PC2	0.00090411
OL044T41	044T41	0.00084
UD119TK6	119AS1	0.000838082
OL033T101	033T101	0.000828493
OL044T101	044T101	0.000828493
EB108H1	108H1	0.00082
UD223FG1	F223FG1	0.000813151
EB025WR1	025WR1	0.000705479

FIN	EPN	Total VOC (tons/day)
OX062C19	062C19	0.002367123
EB025R4	025S122	0.002332877
EB025R5	025S122	0.002332877
OX062C16	062C16	0.002328767
OX062C20	062C20	0.002279452
EPF104FG1	F104FG1	0.00219
PE252F725	252BH725	0.002171233

FIN	EPN	Total VOC (tons/day)
ES633IU1	633IU1	0.000673973
OL228S981	228S981	0.000668493
UD119T7	119T7	0.000644932
EB025R4	025E108	0.000619178
EB025R5	025E108	0.000619178
EB041MNT1	041MT1	0.000605479
OX011ES5	011ES5	0.00059

BIOGENIC EMISSIONS

Biogenic emissions were calculated using data for land-use/land-cover (LULC), temperature and solar radiation (PAR) developed for Northeast Texas by Yarwood et al. (2001). To calculate biogenic emissions with the leaf temperature and drought index options selected, GloBEIS3.1 requires domain definition, LULC, temperature, PAR, drought index, wind speed, and humidity input files. The domain tested was identical for both GloBEIS runs, so input files for domain definition, LULC, and PAR were the same for both and were from Yarwood et al. (2001).

It was necessary to update the meteorological data in order to run GloBEIS3.1 because humidity and wind speed are needed in addition to ambient temperature in order to model leaf temperature. It is important for the temperature and humidity data to be internally consistent to obtain a reasonable relative humidity. To promote internal consistency, all of the meteorological data for GloBEIS3.1 came from MM5 results.

The drought index input files were generated from Palmer Drought Index (PDI) data obtained from the National Weather Service Climate Prediction Center. Drought severity is reported weekly for each climate division as defined by the Climate Prediction Center. These data were obtained in ASCII format from the FTP site (ftp://ftp.ncep.noaa.gov/pub/cpc/htdocs/temp2/) for the time period of interest. Gridded fields of the PDI were developed for the modeling grids using the Arc/INFO 7.2x GIS software. Regional climate divisions for Texas were obtained from Harlan Shannon, USDA/OCE/WAOB, in the form of geospatial shapefiles. The PDI data associated a particular value for the PDI for each climate division for each scenario considered. Climate division shapefiles were imported into Arc/INFO as polygon coverages. The PDI data specific to each climate region were then imported as attribute tables and joined with the spatial coverages. The 12-km modeling domain was generated as a polygon coverage and overlayed with the climate division coverages. Based on the coordinates of the centroid of each modeling grid cell, the corresponding climate division within which each grid cell resides was identified. Finally, the modeling grid cell indices (i,j) and the appropriate value of the PDI was exported as an ASCII text file for input to GloBEIS.

PDI values in the 4-km domain for the three different weeks spanned by the modeling period are illustrated in Figures 3-4, 3-5 and 3-6. Drought conditions are mild to moderate (severe drought would have a PDI of less than -4), with increasing severity over the modeling period. Figures 3-7, 3-8 and 3-9 have a different color scale than Figures 3-4, 3-5 and 3-6, and depict PDI values in the 36-km domain for the three weeks spanned by the modeling period. Note that conditions range from extreme drought in Ohio, Kentucky, West Virginia and some of the other eastern states to extreme wetness in Oklahoma and Kansas.

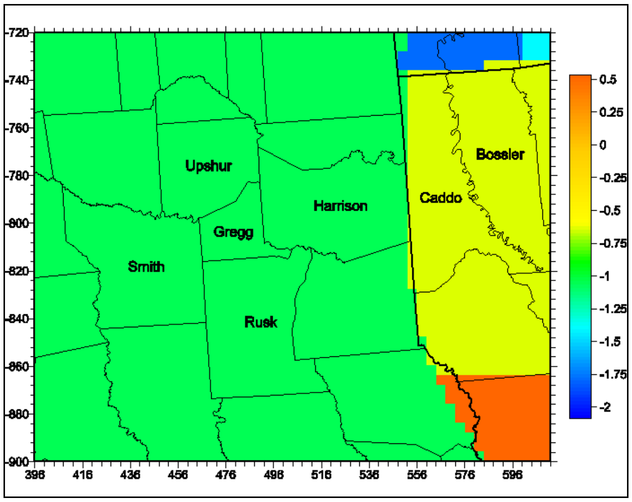


Figure 3-4. Northeast Texas 4-km domain shaded by Palmer Drought Index for August 13-14, 1999.

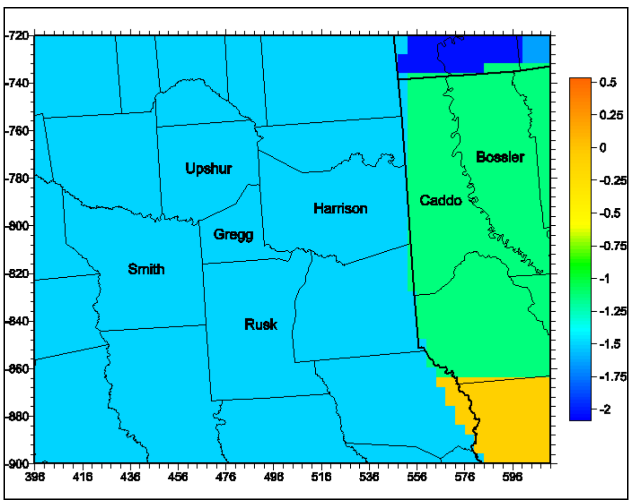


Figure 3-5. Northeast Texas 4-km domain shaded by Palmer Drought Index for August 15-21, 1999.

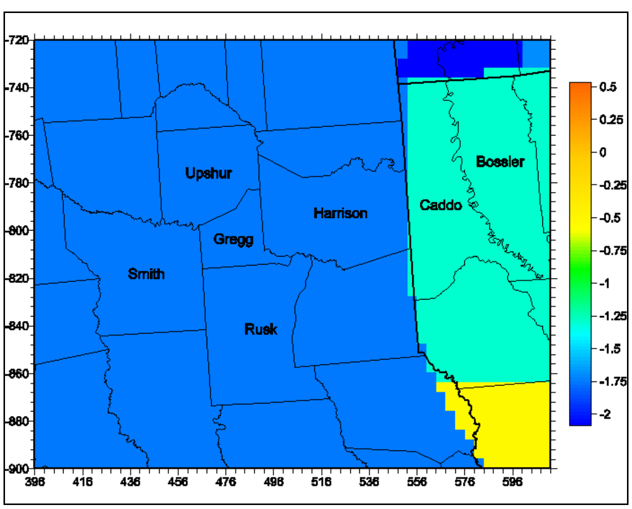


Figure 3-6. Northeast Texas 4-km domain shaded by Palmer Drought Index for August 22, 1999.

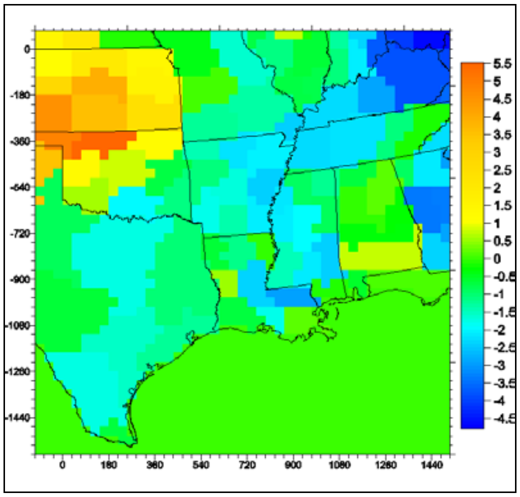


Figure 3-7. Northeast Texas 36-km domain shaded by Palmer Drought Index for August 13-14, 1999.

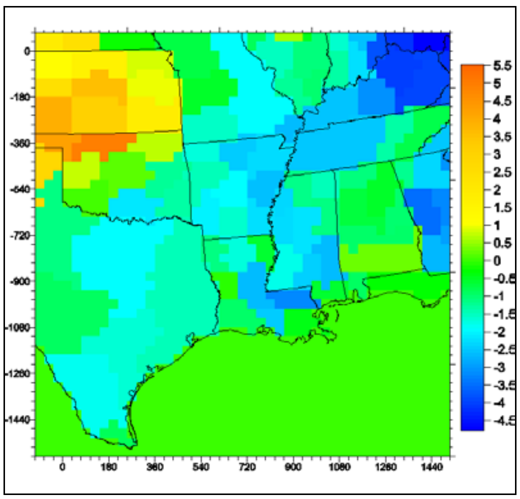


Figure 3-8. Northeast Texas 36-km domain shaded by Palmer Drought Index for August 15-21, 1999.

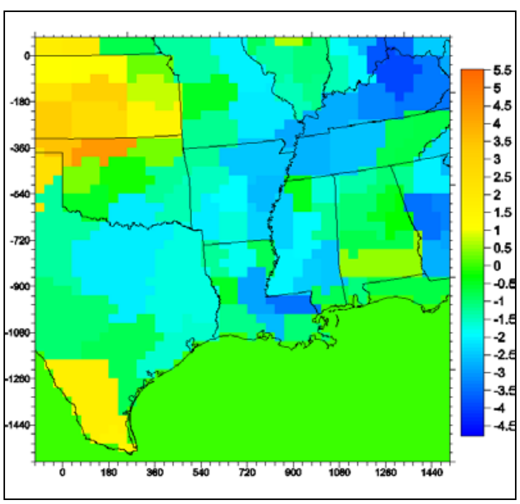


Figure 3-9. Northeast Texas 36-km domain shaded by Palmer Drought Index for August 22, 1999.

GloBEIS3.1 Model and Options

Updated biogenic emissions were prepared using version 3.1 of the GloBEIS model for comparison to the output from version 2.2 (Yarwood et al. 2002). Since the previous release of GloBEIS, version 3.1 has incorporated the following improvements over version 2.2:

- Option to run with variable Leaf Area Index values input
- Option to run with variable leaf age input
- Option to run with drought effects from drought index input
- Option to run with leaf temperature effects calculated from humidity and wind speed inputs
- Option to run with antecedent temperature influence
- Added options to speciate VOC emissions as CB4, SAPRC99 or native speciation, rather than just CB4.
- Updated underlying speciation scheme for other VOC (OVC) emissions.
- Simplified option to adjust isoprene emissions by an arbitrary factor via the “model parameters screen,” which replaced two GloBEIS3 parameters (Database Max Iso EF and Revised Max Iso EF) by a single parameter (Adjust Isoprene Emissions) that has a default setting of 1.0.
- Strengthened internal data consistency checks in the QA module.

Figure 3-10 shows a screen shot with the GloBEIS3.1 model parameters selected. In addition to the inclusion of drought and leaf temperature effects on biogenic emissions, different temperature data were used in current calculations. Previous GloBEIS2.2 biogenic emissions modeling for Northeast Texas utilized hourly temperature data from interpolated National Weather Service observations; GloBEIS3.1 biogenic emissions modeling uses MM5 temperature data as described above.

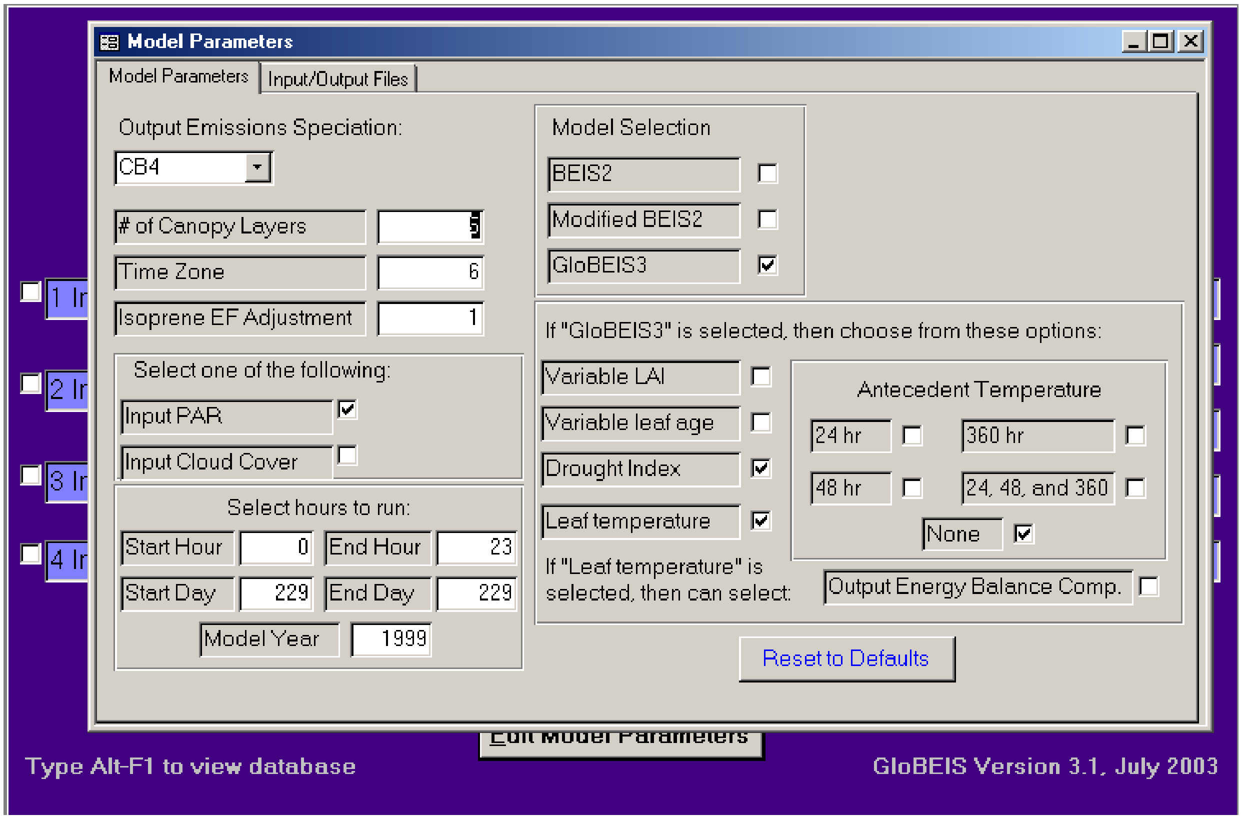


Figure 3-10. GloBEIS3.1 Model Parameters for biogenic emissions modeling.

EMISSIONS RESULTS

Biogenic emissions from GloBEIS were summarized for the five NETAC counties and two Shreveport parishes in the 4-km domain and for all states in the 36-km domain. Tables 3-34, 3-35, 3-36 and 3-37 show the percent change in biogenic emissions of NOx, CO, isoprene and VOCs by county in the 4-km domain for calculations done with GloBEIS3.1 relative to those done with GloBEIS2.2. Overall, emissions of CO, isoprene and VOCs calculated by GloBEIS3.1 were less than those from GloBEIS2.2; NOx emissions barely changed. All seven counties experienced similar effects. Averaged over all days of the modeling period and all counties, CO, isoprene and VOC emissions decreased by about 9%, 13% and 3%, respectively. NOx emissions did not change when averaged over all days and counties.

Inspection of the county-based NOx data alone reveals the effect of using MM5 temperatures instead of interpolated hourly National Weather Service observations, because the GloBEIS NOx emissions are simply a function of the ambient temperature and LULC data. The CO emissions respond to the drought conditions as well as the switch to MM5 temperatures because GloBEIS estimates CO as a fraction of other VOC emissions. For CO, drought conditions decreased emissions more than the temperature changes would have alone. The isoprene emissions also respond to the temperature change and drought, but the drought effects are more complex for isoprene than for other VOC and CO. Guenther, et al. (2002) reported that mild drought (PDI = -0.5 to –2) can slightly increase isoprene emissions, while moderate drought (PDI = -2.5 to –4) tends to decrease emissions. Given the varying mild to moderate drought conditions that existed during the modeling period, the isoprene emissions have a different pattern of change by day and by county than the CO and NOx data. The total VOC emission trends are the most complex because they combine the effects for isoprene, other VOCs and monoterpenes. The decrease in total VOC is smaller than for isoprene or other VOC (as shown by CO) because the monoterpene emissions are not changed by drought.

For the regional modeling domain, Tables 3-38, 3-39, 3-40 and 3-41 show the percent change in biogenic emissions of NOx, CO, isoprene and VOCs by state in the 36-km domain for GloBEIS3.1 relative to GloBEIS2.2. Given the way that temperature and drought affect emissions of these four pollutants (as explained above), the trends are similar to those occurring in the counties of interest, but in some cases are more exaggerated. The CO emission changes best illustrate the striking differences by state caused by the significantly different drought conditions throughout the 36-km domain. Drastically reduced CO emissions in Ohio, West Virginia and other eastern states provide are consistent with the severe drought in that area (Figures 3-7, 3-8 and 3-9).

Table 3-34. Changes in emissions of NOx for seven counties in the Northeast Texas 4-km domain for GloBEIS 3.1 compared to GloBEIS 2.2.

County	FIPS	13-Aug	14-Aug	15-Aug	16-Aug	17-Aug	18-Aug	19-Aug	20-Aug	21-Aug	22-Aug	Period Avg.
Gregg	48183	-14%	-7%	-1%	8%	6%	3%	2%	-3%	2%	2%	**0%**
Harrison	48203	-11%	-6%	1%	9%	7%	4%	4%	-1%	2%	3%	**1%**
Rusk	48401	-11%	-4%	0%	8%	4%	2%	2%	-3%	2%	2%	**0%**
Smith	48423	-14%	-9%	-4%	5%	4%	2%	1%	-5%	0%	0%	**-2%**
Upshur	48459	-14%	-8%	-3%	5%	5%	2%	1%	-4%	2%	0%	**-1%**
Bossier	22015	-8%	-6%	4%	7%	4%	4%	4%	1%	3%	3%	**2%**
Caddo	22017	-8%	-6%	5%	8%	6%	4%	4%	1%	3%	4%	**2%**

Table 3-35. Changes in emissions of CO for seven counties in the Northeast Texas 4-km domain for GloBEIS 3.1 compared to GloBEIS 2.2.

County	FIPS	13-Aug	14-Aug	15-Aug	16-Aug	17-Aug	18-Aug	19-Aug	20-Aug	21-Aug	22-Aug	Period Avg.
Gregg	48183	-23%	-15%	-7%	2%	-5%	-10%	-10%	-12%	-6%	-7%	**-9%**
Harrison	48203	-19%	-14%	-4%	3%	-4%	-8%	-9%	-10%	-6%	-6%	**-8%**
Rusk	48401	-19%	-12%	-6%	2%	-7%	-8%	-11%	-13%	-6%	-7%	**-9%**
Smith	48423	-23%	-19%	-12%	-2%	-7%	-11%	-12%	-16%	-9%	-10%	**-12%**
Upshur	48459	-24%	-16%	-9%	-2%	-6%	-12%	-12%	-14%	-6%	-10%	**-11%**
Bossier	22015	-15%	-13%	0%	2%	-5%	-7%	-8%	-5%	-4%	-5%	**-6%**
Caddo	22017	-16%	-14%	-1%	2%	-4%	-7%	-9%	-7%	-5%	-5%	**-6%**

Table 3-36. Changes in emissions of isoprene for seven counties in the Northeast Texas 4-km domain for GloBEIS 3.1 compared to GloBEIS 2.2.

County	FIPS	13-Aug	14-Aug	15-Aug	16-Aug	17-Aug	18-Aug	19-Aug	20-Aug	21-Aug	22-Aug	Period Avg.
Gregg	48183	-15%	-21%	-11%	-12%	-20%	-16%	-16%	-12%	-10%	-12%	**-14%**
Harrison	48203	-8%	-17%	-9%	-11%	-16%	-14%	-14%	-9%	-10%	-10%	**-12%**
Rusk	48401	-11%	-21%	-11%	-13%	-19%	-15%	-15%	-13%	-13%	-13%	**-14%**
Smith	48423	-15%	-26%	-15%	-15%	-21%	-17%	-16%	-16%	-14%	-14%	**-17%**
Upshur	48459	-14%	-19%	-12%	-12%	-18%	-18%	-16%	-13%	-10%	-13%	**-14%**
Bossier	22015	-4%	-10%	-5%	-11%	-16%	-12%	-13%	-4%	-6%	-11%	**-9%**
Caddo	22017	-5%	-15%	-8%	-14%	-18%	-14%	-14%	-7%	-9%	-13%	**-12%**

Table 3-37. Changes in emissions of VOC for seven counties in the Northeast Texas 4-km domain for GloBEIS 3.1 compared to GloBEIS 2.2.

County	FIPS	13-Aug	14-Aug	15-Aug	16-Aug	17-Aug	18-Aug	19-Aug	20-Aug	21-Aug	22-Aug	Period Avg.
Gregg	48183	-12%	-11%	-2%	2%	-6%	-6%	-6%	-4%	-1%	-2%	**-5%**
Harrison	48203	-5%	-7%	2%	4%	-3%	-3%	-3%	-1%	1%	0%	**-1%**
Rusk	48401	-6%	-9%	1%	3%	-4%	-3%	-4%	-5%	-1%	-1%	**-3%**
Smith	48423	-12%	-16%	-5%	-2%	-7%	-6%	-6%	-9%	-3%	-4%	**-7%**
Upshur	48459	-11%	-9%	-2%	2%	-4%	-6%	-5%	-5%	1%	-3%	**-4%**
Bossier	22015	-1%	-3%	6%	3%	-4%	-2%	-3%	5%	3%	-1%	**0%**
Caddo	22017	-1%	-7%	3%	0%	-5%	-3%	-4%	2%	1%	-2%	**-2%**

Table 3-38. Change in emissions of NOx for states in the Northeast Texas 36-km domain for GloBEIS 3.1 compared to GloBEIS 2.2.

State	FIPS	13-Aug	14-Aug	15-Aug	16-Aug	17-Aug	18-Aug	19-Aug	20-Aug	21-Aug	22-Aug	Period Avg.
Alabama	01	-8%	-8%	-1%	-5%	-6%	-6%	-7%	-8%	-3%	-6%	**-6%**
Arkansas	05	-6%	-4%	-1%	-1%	1%	1%	-3%	-3%	-1%	-2%	**-2%**
Florida	12	-1%	-4%	-1%	-6%	-8%	-3%	-2%	-3%	-3%	-5%	**-4%**
Georgia	13	-2%	-10%	-4%	-8%	-12%	-13%	-11%	-5%	-3%	-6%	**-7%**
Illinois	17	1%	-1%	1%	0%	2%	1%	-3%	0%	2%	1%	**0%**
Indiana	18	-2%	-2%	-1%	2%	0%	-1%	-8%	-5%	-1%	0%	**-2%**
Kansas	20	3%	4%	-4%	-3%	-4%	-1%	0%	1%	0%	0%	**0%**
Kentucky	21	-11%	-3%	-2%	0%	-2%	-3%	-5%	-3%	-1%	1%	**-3%**
Louisiana	22	-6%	-8%	0%	1%	0%	-3%	-5%	-4%	-2%	-2%	**-3%**
Mississippi	28	-6%	-3%	1%	2%	3%	4%	-1%	-2%	-2%	-1%	**-1%**
Missouri	29	1%	-1%	1%	2%	8%	5%	2%	1%	2%	3%	**2%**
Nebraska	31	1%	3%	-4%	-3%	-1%	1%	2%	1%	0%	2%	**0%**
North Carolina	37	-12%	-21%	-15%	-14%	-17%	-21%	-13%	-13%	-14%	-13%	**-15%**
Ohio	39	-11%	2%	-3%	-1%	-5%	-6%	-1%	-6%	-3%	1%	**-3%**
Oklahoma	40	0%	3%	-4%	-3%	-2%	2%	-1%	0%	0%	-9%	**-2%**
South Carolina	45	-1%	-13%	-3%	-9%	-13%	-11%	-7%	-3%	-1%	-5%	**-7%**
Tennessee	47	-10%	-3%	-2%	0%	0%	-1%	-3%	0%	-1%	1%	**-2%**

State	FIPS	13-Aug	14-Aug	15-Aug	16-Aug	17-Aug	18-Aug	19-Aug	20-Aug	21-Aug	22-Aug	Period Avg.
Virginia	51	-8%	-6%	-6%	0%	-1%	-5%	-3%	-6%	-6%	2%	**-4%**
West Virginia	54	5%	9%	2%	3%	0%	-3%	7%	3%	-1%	7%	**3%**

Table 3-39. Change in emissions of CO for states in the Northeast Texas 36-km domain for GloBEIS 3.1 compared to GloBEIS 2.2.

State	FIPS	13-Aug	14-Aug	15-Aug	16-Aug	17-Aug	18-Aug	19-Aug	20-Aug	21-Aug	22-Aug	Period Avg.
Alabama	01	-15%	-15%	-3%	-10%	-14%	-13%	-18%	-17%	-8%	-15%	**-13%**
Arkansas	05	-17%	-13%	-9%	-8%	-9%	-9%	-18%	-12%	-9%	-13%	**-12%**
Florida	12	-5%	-8%	-3%	-10%	-13%	-6%	-5%	-6%	-5%	-9%	**-7%**
Georgia	13	-27%	-37%	-31%	-36%	-39%	-39%	-38%	-33%	-30%	-32%	**-34%**
Illinois	17	-1%	-3%	2%	-3%	-3%	-5%	-4%	-1%	-1%	-4%	**-2%**
Indiana	18	-18%	-16%	-18%	-15%	-19%	-22%	-27%	-22%	-20%	-18%	**-19%**
Kansas	20	3%	3%	-10%	-11%	-7%	-7%	-5%	-3%	-6%	-6%	**-5%**
Kentucky	21	-47%	-40%	-46%	-45%	-48%	-48%	-46%	-46%	-46%	-39%	**-45%**
Louisiana	22	-17%	-17%	-10%	-10%	-14%	-18%	-20%	-16%	-15%	-18%	**-16%**
Mississippi	28	-12%	-10%	-8%	-8%	-10%	-8%	-13%	-17%	-16%	-14%	**-12%**
Missouri	29	1%	-3%	0%	-2%	5%	3%	-1%	-2%	-1%	-4%	**0%**
Nebraska	31	2%	4%	-6%	-4%	0%	2%	1%	1%	-3%	1%	**0%**
North Carolina	37	-27%	-36%	-34%	-35%	-38%	-42%	-36%	-32%	-34%	-30%	**-34%**
Ohio	39	-78%	-75%	-79%	-79%	-80%	-80%	-79%	-80%	-79%	-22%	**-73%**
Oklahoma	40	-15%	-11%	-16%	-13%	-12%	-9%	-12%	-11%	-9%	-17%	**-12%**
South Carolina	45	-33%	-43%	-37%	-43%	-46%	-44%	-42%	-37%	-35%	-27%	**-39%**
Tennessee	47	-21%	-13%	-15%	-12%	-15%	-17%	-20%	-15%	-15%	-16%	**-16%**
Virginia	51	-54%	-51%	-55%	-51%	-51%	-54%	-53%	-54%	-54%	-43%	**-52%**
West Virginia	54	-56%	-55%	-65%	-65%	-66%	-67%	-62%	-65%	-66%	-19%	**-59%**

Table 3-40. Change in emissions of isoprene for states in the Northeast Texas 36-km domain for GloBEIS 3.1 compared to GloBEIS 2.2.

State	FIPS	13-Aug	14-Aug	15-Aug	16-Aug	17-Aug	18-Aug	19-Aug	20-Aug	21-Aug	22-Aug	Period Avg.
Alabama	01	-19%	-20%	-5%	-14%	-16%	-15%	-21%	-21%	-12%	-21%	**-16%**
Arkansas	05	-13%	-11%	-10%	-13%	-16%	-14%	-17%	-12%	-11%	-18%	**-14%**
Florida	12	-13%	-22%	-3%	-9%	-17%	-6%	-4%	-8%	-5%	-11%	**-10%**
Georgia	13	-30%	-39%	-26%	-33%	-39%	-36%	-36%	-33%	-26%	-29%	**-33%**
Illinois	17	0%	-6%	0%	-6%	-6%	-8%	-7%	-2%	-6%	-11%	**-5%**
Indiana	18	-16%	-13%	-14%	-12%	-20%	-22%	-19%	-19%	-18%	-17%	**-17%**
Kansas	20	6%	1%	-12%	-9%	-9%	-11%	-8%	-8%	-11%	-13%	**-8%**
Kentucky	21	-45%	-33%	-43%	-41%	-46%	-46%	-42%	-39%	-44%	-38%	**-42%**
Louisiana	22	-13%	-20%	-14%	-17%	-19%	-21%	-22%	-17%	-17%	-23%	**-18%**
Mississippi	28	-10%	-11%	-7%	-14%	-15%	-13%	-15%	-16%	-17%	-19%	**-14%**
Missouri	29	5%	-5%	1%	-3%	5%	3%	-4%	-2%	-4%	-10%	**-1%**
Nebraska	31	-1%	-1%	-9%	-9%	-1%	2%	-3%	0%	-8%	-1%	**-3%**

State	FIPS	13-Aug	14-Aug	15-Aug	16-Aug	17-Aug	18-Aug	19-Aug	20-Aug	21-Aug	22-Aug	Period Avg.
North Carolina	37	-34%	-43%	-36%	-38%	-43%	-48%	-38%	-39%	-38%	-38%	**-39%**
Ohio	39	-78%	-72%	-80%	-80%	-81%	-80%	-79%	-79%	-80%	-18%	**-73%**
Oklahoma	40	-14%	-10%	-16%	-14%	-16%	-14%	-14%	-15%	-10%	-16%	**-14%**
South Carolina	45	-40%	-44%	-32%	-41%	-47%	-44%	-40%	-37%	-33%	-28%	**-39%**
Tennessee	47	-18%	-13%	-15%	-12%	-19%	-19%	-21%	-13%	-17%	-22%	**-17%**
Virginia	51	-54%	-54%	-60%	-52%	-52%	-53%	-56%	-56%	-56%	-43%	**-54%**
West Virginia	54	-53%	-46%	-65%	-63%	-65%	-64%	-61%	-59%	-64%	-16%	**-55%**

Table 3-41. Change in emissions of VOC for states in the Northeast Texas 36-km domain for GloBEIS 3.1 compared to GloBEIS 2.2.

State	FIPS	13-Aug	14-Aug	15-Aug	16-Aug	17-Aug	18-Aug	19-Aug	20-Aug	21-Aug	22-Aug	Period Avg.
Alabama	01	-10%	-10%	5%	-4%	-7%	-6%	-13%	-11%	-2%	-10%	**-7%**
Arkansas	05	-6%	-3%	-1%	-3%	-6%	-4%	-10%	-3%	-1%	-8%	**-5%**
Florida	12	3%	-2%	10%	2%	-4%	6%	7%	5%	7%	2%	**4%**
Georgia	13	-17%	-29%	-16%	-23%	-29%	-27%	-27%	-21%	-15%	-20%	**-22%**
Illinois	17	9%	5%	10%	3%	3%	4%	4%	8%	4%	-1%	**5%**
Indiana	18	-7%	1%	-4%	-2%	-10%	-11%	-10%	-9%	-7%	-7%	**-7%**
Kansas	20	19%	15%	-1%	1%	3%	2%	5%	8%	3%	4%	**6%**
Kentucky	21	-37%	-20%	-32%	-32%	-37%	-37%	-33%	-29%	-34%	-28%	**-32%**
Louisiana	22	-5%	-9%	-1%	-3%	-6%	-10%	-11%	-6%	-5%	-10%	**-7%**
Mississippi	28	-2%	-2%	2%	-3%	-4%	-2%	-6%	-8%	-8%	-9%	**-4%**
Missouri	29	12%	3%	8%	4%	12%	11%	4%	6%	4%	-2%	**6%**
Nebraska	31	15%	12%	2%	3%	11%	14%	11%	13%	5%	14%	**10%**
North Carolina	37	-25%	-36%	-28%	-30%	-35%	-41%	-30%	-29%	-29%	-29%	**-31%**
Ohio	39	-67%	-49%	-66%	-68%	-70%	-69%	-64%	-66%	-68%	-6%	**-59%**
Oklahoma	40	-7%	-2%	-9%	-6%	-8%	-6%	-6%	-6%	-2%	-9%	**-6%**
South Carolina	45	-26%	-35%	-22%	-31%	-37%	-34%	-31%	-25%	-22%	-18%	**-28%**
Tennessee	47	-12%	-3%	-6%	-4%	-10%	-11%	-13%	-3%	-8%	-12%	**-8%**
Virginia	51	-45%	-43%	-47%	-42%	-43%	-44%	-46%	-44%	-45%	-33%	**-43%**
West Virginia	54	-43%	-29%	-52%	-53%	-56%	-55%	-50%	-46%	-54%	-5%	**-44%**

4. METEOROLOGY

CAMx requires meteorological input data for the parameters described in Table 4-1.

Table 4-1. CAMx meteorological input data requirements.

CAMx Input Parameter	Description
Layer interface height (m)	3-D gridded time-varying layer heights for the start and end of each hour
Winds (m/s)	3-D gridded wind vectors (u,v) for the start and end of each hour
Temperature (K)	3-D gridded temperature and 2-D gridded surface temperature for the start and end of each hour
Pressure (mb)	3-D gridded pressure for the start and end of each hour
Vertical Diffusivity (m^2/s)	3-D gridded vertical exchange coefficients for each hour
Water Vapor (ppm)	3-D gridded water vapor mixing ratio for each hour
Clouds and Rainfall (g/m^3)	3-D gridded cloud and rain liquid water content for each hour

MM5 MODELING

All of the CAMx meteorological input data were derived from the Fifth Generation Pennsylvania State University/National Center for Atmospheric Research (PSU/NCAR) Mesoscale Model (MM5; Duhdia, 1993). The meteorological modeling reports for this study (Emery and Tai, 2002; Emery, Tai and Jia, 2003) describe the MM5 model, the meteorological domain, and input data sources and preparation methodology. The MM5 modeling used nested 108 km, 36 km, 12 km and 4 km grids and the grid configuration for the final MM5 run (Run 6) is shown in Figure 4-1. The MM5 modeling used 28 layers as described below.

The meteorological modeling reports (Emery and Tai, 2002; Emery, Tai and Jia, 2003) present the performance evaluation methodology and results for several different runs, both graphically and statistically, and recommend a final set of meteorological fields for use in CAMx. These results are summarized briefly below.

MM5 Runs

Several MM5 configurations were considered in developing the final meteorology data for CAMx:

- “Run 3b”, the final of four original MM5 runs described by Emery and Tai (2002). Important model configuration options included the Gayno-Seaman boundary layer scheme, Dudhia Cloud radiation parameterization, Kain-Fritsch cumulus parameterization, “simple ice” cloud microphysics, 5-layer soil model, analysis nudging to EDAS initialization fields, and observation nudging to surface data and soundings/profilers.

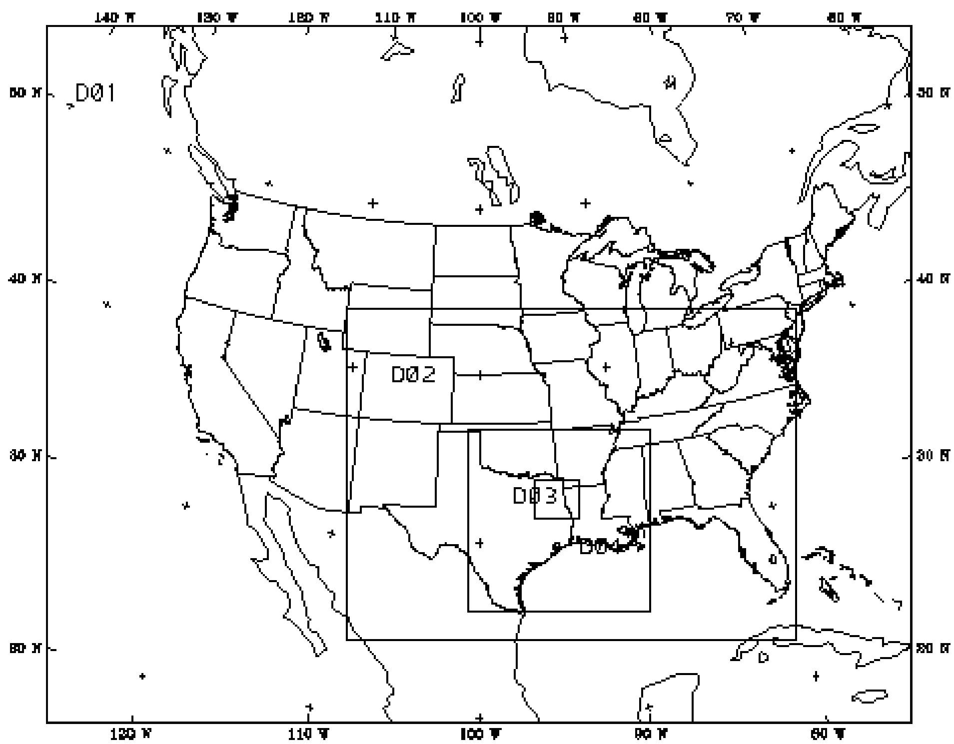


Figure 4-1. The MM5 grid system (108/36/12/4 km) for Run 6.

- "Run 5", the first of three sensitivity runs described by Emery, Tai and Jia (2003), in which the Gayno-Seaman boundary layer scheme was replaced by the Blackadar scheme.

- "Run 5b", the second of three sensitivity runs that continued to use the Blackadar boundary layer scheme but changed the radiation parameterization from Dudhia Cloud to RRTM.

- "Run 6", a final revised MM5 application that included the Pleim-Xiu coupled land surface and boundary layer model, the RRTM radiation parameterization, a revised domain definition with a slightly larger 36-km grid, revised data assimilation (FDDA) methodology, and analysis nudging to EDAS "analysis" rather than "initialization" fields.

As described by Emery, Tai and Jia (2003), "Run 6" was considered the best overall performing meteorological simulation and is the basis for the Northeast Texas EAC ozone modeling. The basis for selecting "Run 6" is discussed below.

Stagnation During the August 1999 Episode

An important difference among the MM5 simulations was the strength of meteorological stagnation predicted over Northeast Texas during the August 17-20 period. Lower wind speeds were observed during this period than immediately before or afterwards, leading to a period of high ozone levels. However, the meteorological fields predicted by MM5 in Runs 3b, 5 and 5b were too stagnant during this time leading to excessively high peak ozone levels in Northeast Texas. This problem was traced primarily to the meteorological data being used for analysis nudging in the MM5 4-dimensional data assimilation (4DDA). MM5 Runs 3b, 5, and 5b assimilated data from EDAS "initialization" data. The initialization data are developed during the spin-up period for the operational Eta forecast model, during which time the model is being guided by its own assimilation of analyzed meteorological data (the EDAS "analysis" data). MM5 run 6 assimilated the EDAS analysis data directly.

The difference in the amount of stagnation predicted by MM5 in Runs 5b and 6 was not obvious from statistical evaluations of predicted wind speeds and directions. However, the difference is clear in the predicted wind and pressure patterns. Figures 4-2 through 4-5 present a series of surface wind and sea level pressure plots for August 17th, 1999 at 6 PM CST for the area of the MM5 12 km grid. Figures 4-2 and 4-3 show the MM5 predicted surface winds and pressure for Runs 5b and 6, respectively. Over Northeast Texas, MM5 Run 5b predicted a local high (1018 mbar) with winds organized around the high. In contrast, MM5 Run 6 predicted weak and disorganized winds over Northeast Texas with no local pressure high. The primary reason for this difference is the data used for the 4DDA analysis nudging. Figures 4-4 and 4-5 show the EDAS initialization and analysis fields, respectively, for this same time. The initialization fields (used with MM5

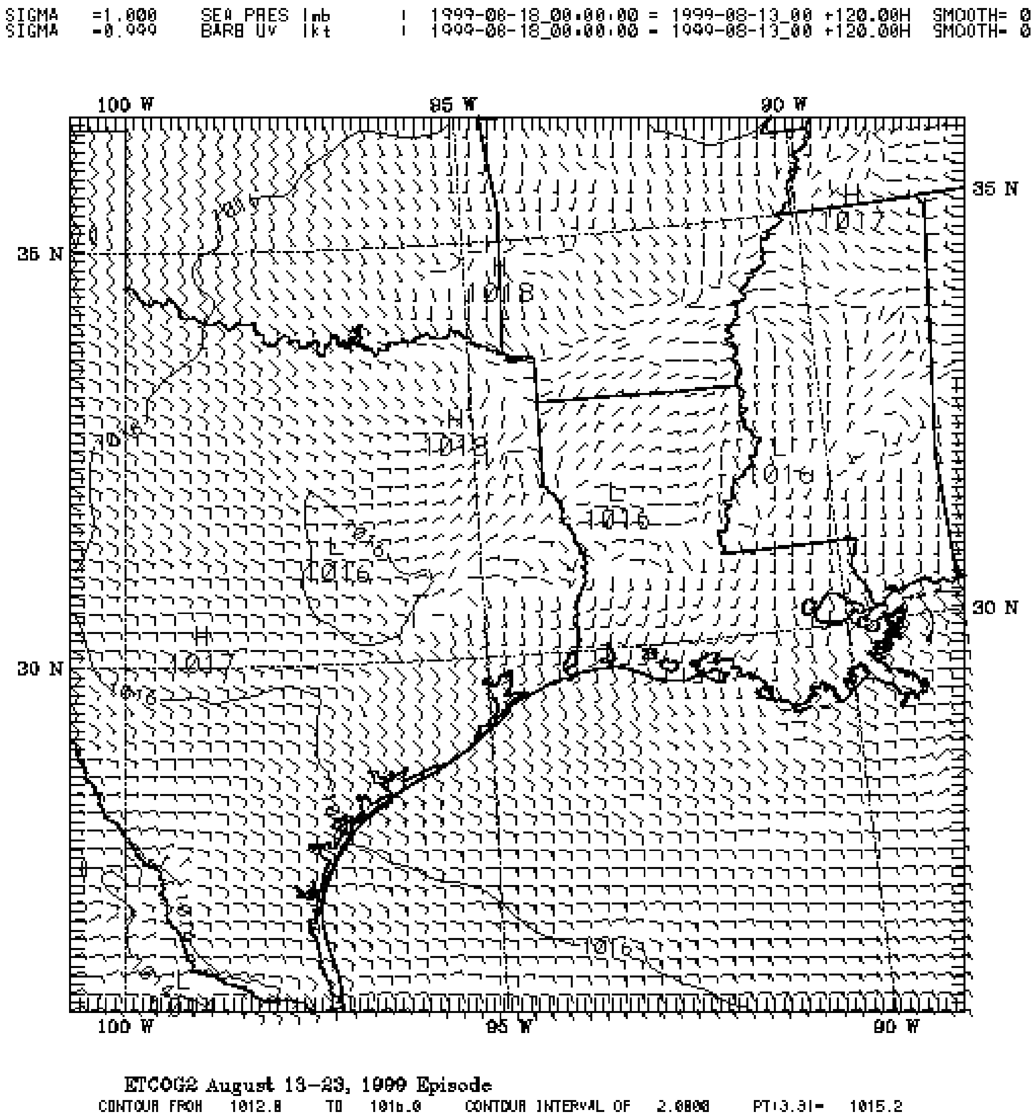


Figure 4-2. MM5 Run 5b surface winds and sea level pressure on August 17, 1999, 6 PM CST.

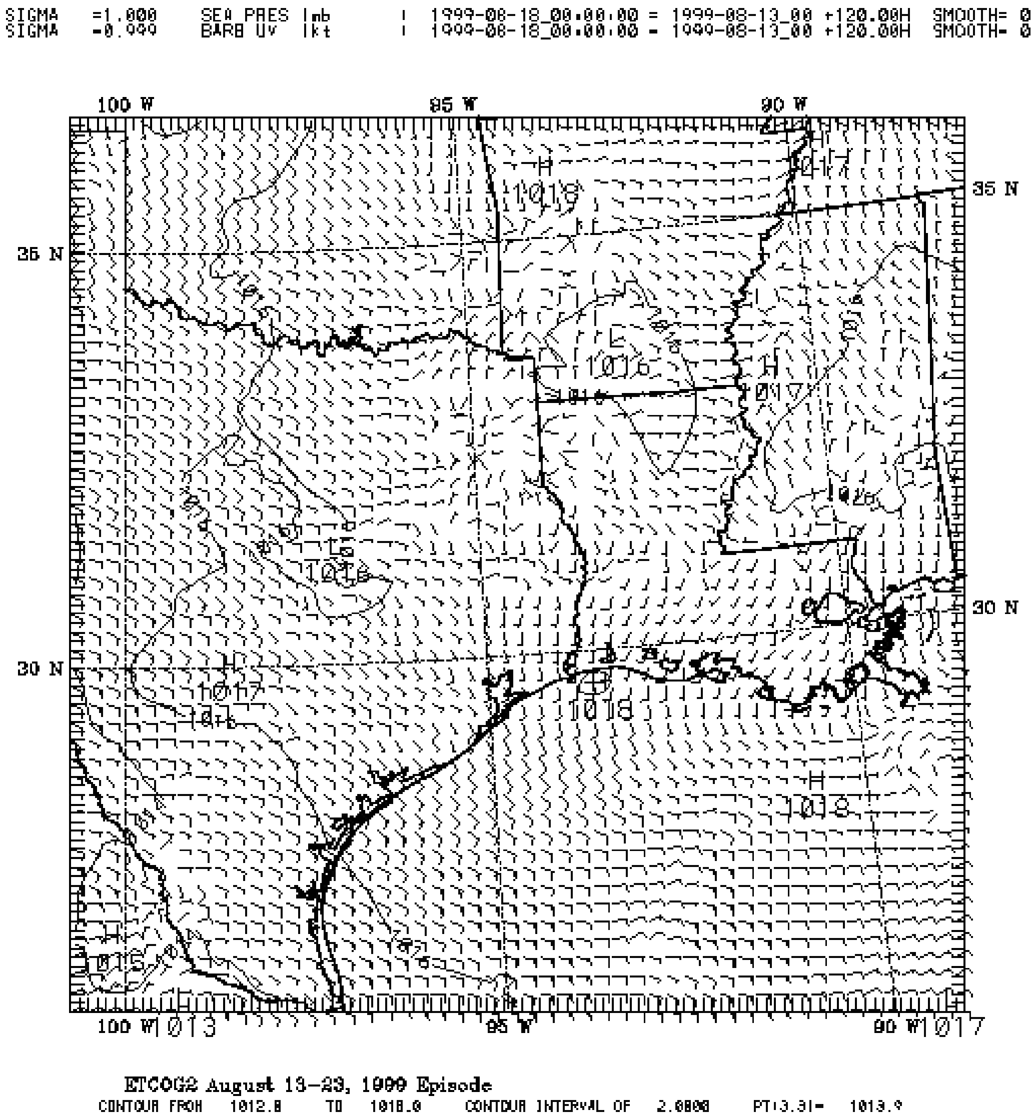


Figure 4-3. MM5 Run 6 surface winds and sea level pressure on August 17, 1999, 6 PM CST.

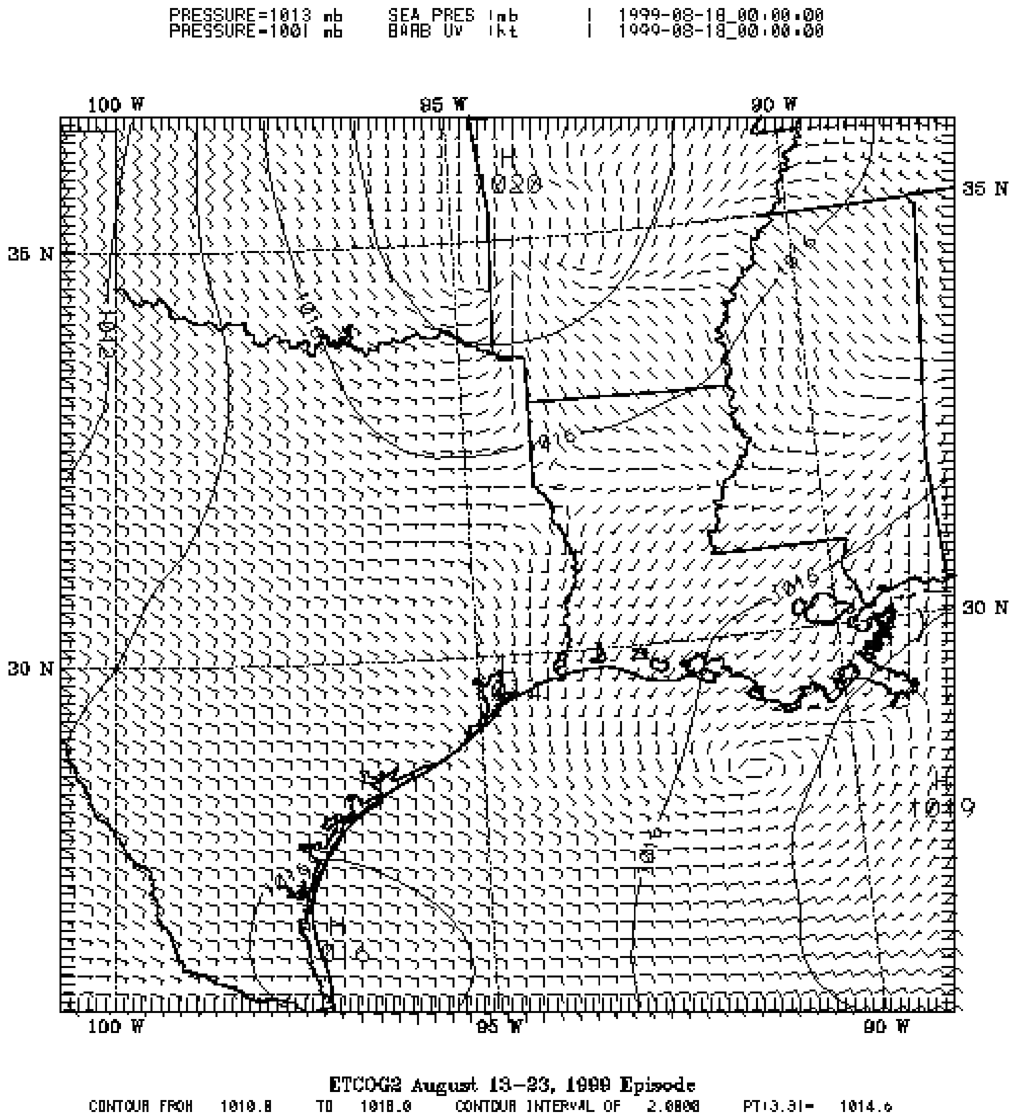


Figure 4-4. EDAS "initialization" surface winds and sea level pressure used to nudge MM5 Run 5B on August 17, 1999, 6 PM CST.

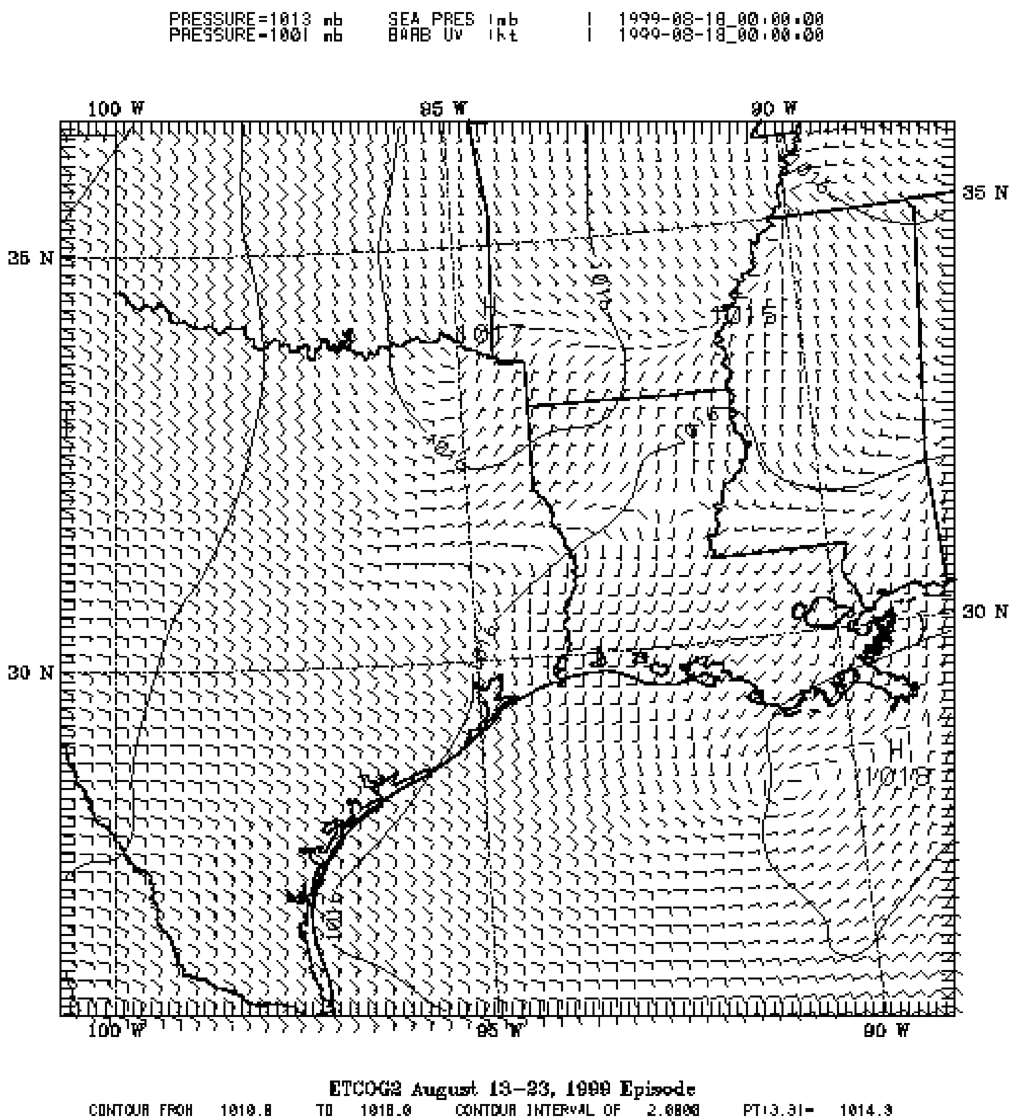


Figure 4-5. EDAS "analysis" surface winds and sea level pressure used to nudge MM5 Run 6 on August 17, 1999, 6 PM CST.

Run 5b) have higher pressure over Northeast Texas than the analysis fields (used with MM5 Run 6). Comparison of the EDAS fields to archived daily weather maps showed that high pressure in Northeast Texas was over-stated by the EDAS initialization fields.

The modeled and observed winds and temperatures at Longview (CAMS 19) are compared in Figures 4-6 and 4-7, respectively. Overall, both runs replicate the observed winds quite well and it is difficult to say that one or other is better. Both follow the observed speed trends well, but both generally over predicted by about 1 m/s on average. The same general conclusions are reached for wind direction, although Run 5b perhaps indicates a slightly more noisy performance. The temperature predictions show that Run 6 was generally too warm during the day during the mid to late portions of the episode. Run 5b generally under predicted temperatures during much of the period. Overall, Run 6 provides a better balance for temperature performance.

Boundary Layer Depths

Vertical profiles of observed wind, temperature and humidity from Shreveport and Palestine were compared to the soundings simulated by MM5 in Runs 3b, 5b, and 6. In Shreveport, Runs 5b and 6 typically performed better for winds than Run 3b (with Run 6 the best overall), which we believe is related to the issues identified with the Gayno-Seaman boundary layer scheme used in Run 3b. While Run 6 consistently over predicted the temperature profile in the boundary layer, it agreed most closely with the observed profile. Runs 3b and 5b were cooler than observed through the boundary layer, and generally indicated more static stability and slightly lower mixing depths than observed. Run 6 also typically performed better for boundary layer humidity than the other runs (least error), but humidity was often slightly under predicted. Usually, Runs 3b and 5b over estimated surface and boundary layer humidity. While Runs 3b and 5b seemed to place the top of the boundary layer near or below the observed level, the mixing depth in Run 6 was higher than observed. Very similar results were seen for the three MM5 simulations at the Palestine site.

The spatial patterns of boundary layer heights over the south-central U.S. were further assessed for Runs 5b and 6. Run 6, which used the Plein-Xiu coupled surface-boundary layer model, consistently developed deeper mixing depths throughout the south-central U.S. than Run 5b, which used the Blackadar boundary layer model. Typically, the Run 5b depths over East Texas ranged from 1000 – 2000 m, whereas the Run 6 depths were usually 2000-2500 m. Run 3b generated mixing depths similar to Run 5b but the mixing depths showed large spatial variability that was unreasonable and appeared to be an artifact of the Gayno-Seaman boundary layer scheme. This characteristic may have the largest impacts on air quality simulations, far more than any wind or temperature differences.

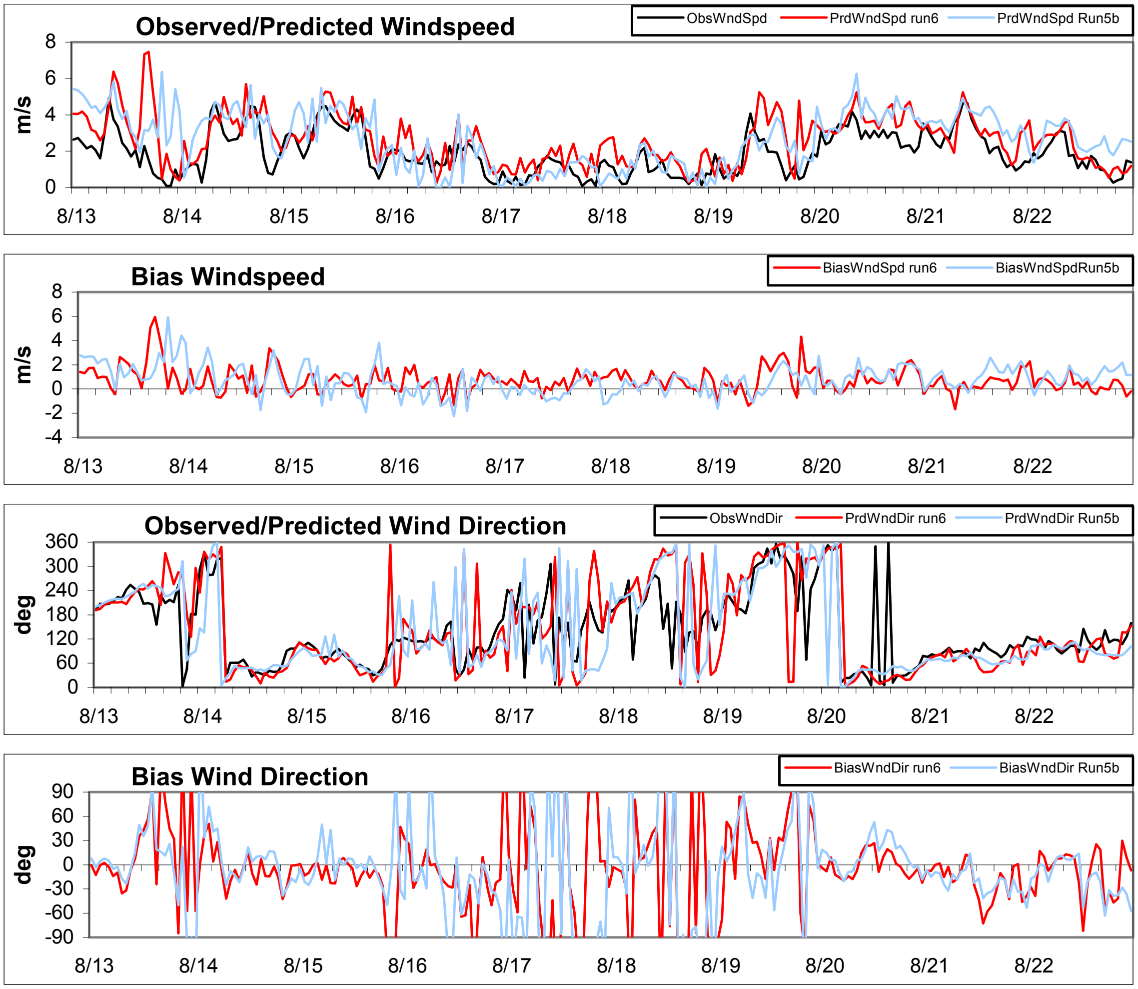


Figure 4-6. Hourly predicted (Runs 5b and 6) and observed wind speed and direction at Longview (CAMS 19).

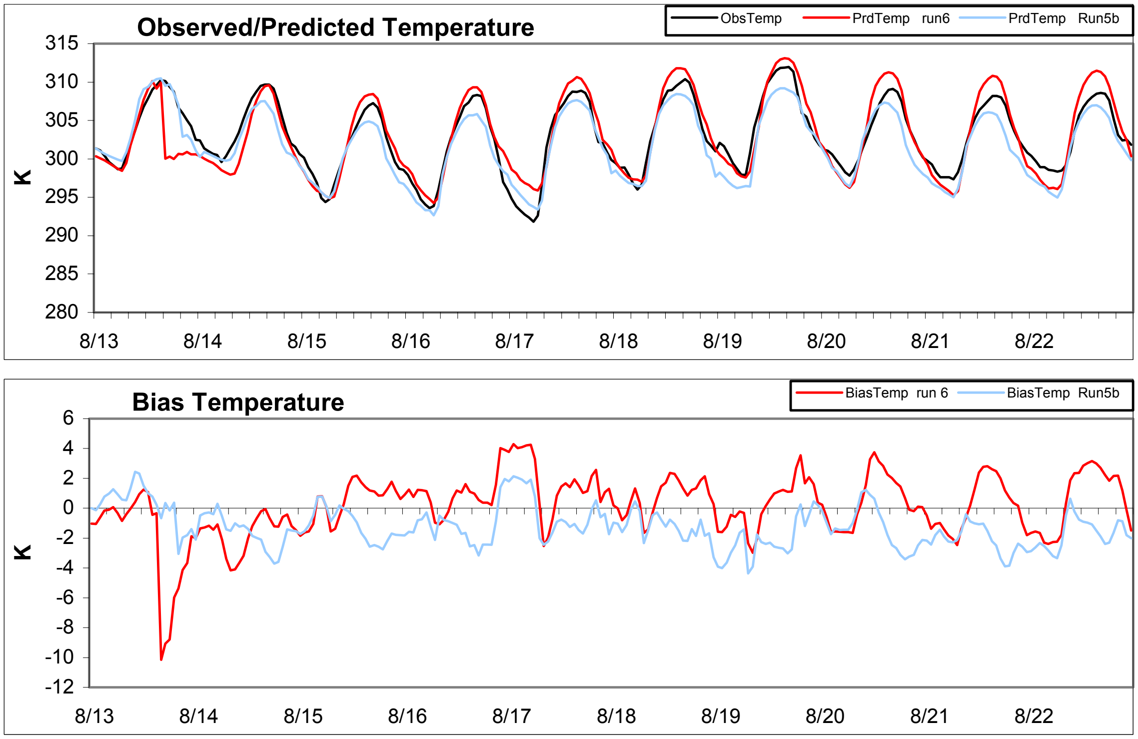


Figure 4-7. Hourly predicted (Runs 5b and 6) and observed temperature at Longview (CAMS 19).

CAMx INPUT DATA PREPARATION

MM5 output fields were translated to CAMx-ready inputs using ENVIRON's MM5CAMx translation software. This program performs several functions:

1. Extracts wind, temperature, pressure, humidity, cloud, and rain fields from each MM5 grid that matches the corresponding CAMx grid.
2. Performs mass-weighted vertical aggregation of data for CAMx layers that span multiple MM5 layers.
3. Diagnoses fields of vertical diffusion coefficient (Kv), which are not directly output by MM5.
4. Outputs the meteorological data into CAMx-ready input files.

The MM5CAMx program has been written to carefully preserve the consistency of the predicted wind, temperature and pressure fields output by MM5. This is the key to preparing mass-consistent inputs, and therefore for obtaining the best possible performance from CAMx.

The data prepared by MM5CAMx were directly input to CAMx. Meteorological inputs were developed for a 15-layer CAMx application (Figure 4-8). Every MM5 layer below ~3800m above ground level was mapped directly to a CAMx layer. The CAMx surface layer was ~20 m deep.

Vertical diffusivities are an important input to the CAMx simulation since they determine the rate and depth of mixing in the planetary boundary layer (PBL) and above. In general, diffusivities directly output from meteorological models, or diffusivities diagnosed from other output variables, require careful examination before they are used in air quality modeling. This may be because the air quality model results are much more sensitive to diffusivities than the meteorological model results. In CAMx simulations using meteorology from MM5 "Run 3b" the vertical diffusivities were calculated from output fields of turbulent kinetic energy predicted by the Gayno-Seaman boundary layer model. This approach is preferred as it provides a direct means to translate turbulence intensity in MM5 to diffusion rates in CAMx. For MM5 simulations "Run 5," "Run 5b"and "Run 6" the MM5 boundary layer (mixing) depths were used to define a profile of vertical diffusivity values in each grid column, depending on surface layer stability and the underlying surface characteristics. The methodology follows from O'Brien (1970). This method was necessary because the Blackadar and Pleim-Xiu PBL schemes do not generate fields of turbulent kinetic energy.

Layer	sigma	pressure	height	thickness	CAMx Layers
28	0.0000	50.00	18874.41	1706.76	
27	0.0250	73.75	17167.65	1362.47	
26	0.0500	97.50	15805.17	2133.42	
25	0.1000	145.00	13671.75	1664.35	
24	0.1500	192.50	12007.40	1376.75	
23	0.2000	240.00	10630.65	1180.35	
22	0.2500	287.50	9450.30	1036.79	
21	0.3000	335.00	8413.52	926.80	
20	0.3500	382.50	7486.72	839.57	
19	0.4000	430.00	6647.15	768.53	
18	0.4500	477.50	5878.62	709.45	
17	0.5000	525.00	5169.17	659.47	
16	0.5500	572.50	4509.70	616.58	
15	0.6000	620.00	**3893.12**	579.34	--15---
14	0.6500	667.50	**3313.78**	546.67	--14---
13	0.7000	715.00	**2767.11**	517.77	--13---
12	0.7500	762.50	**2249.35**	491.99	--12---
11	0.8000	810.00	**1757.36**	376.81	--11---
10	0.8400	848.00	**1380.55**	273.60	--10---
9	0.8700	876.50	**1106.95**	266.37	---9---
8	0.9000	905.00	**840.58**	259.54	---8---
7	0.9300	933.50	**581.04**	169.41	---7---
6	0.9500	952.50	**411.63**	166.65	---6---
5	0.9700	971.50	**244.98**	82.31	---5---
4	0.9800	981.00	**162.67**	65.38	---4---
3	0.9880	988.60	**97.29**	56.87	---3---
2	0.9950	995.25	**40.43**	20.23	---2---
1	0.9975	997.62	**20.19**	20.19	---1---
0	1.0000	1000.00	**0.00**		=============Surface======

Figure 4-8. MM5 and CAMx vertical grid structures based on 28 sigma-p levels. Heights (m) are above ground level according to a standard atmosphere; pressure is in millibars.

5. OTHER CAMx INPUT DATA

The emissions and meteorological input data for the CAMx ozone modeling were described in Sections 3 and 4, respectively. The other input data and model options are described in this section of the report. The ozone modeling used the Comprehensive Air quality Model with extensions (CAMx) version 4.02 photochemical grid model (ENVIRON, 2004).

MODELING DOMAIN

The following factors were considered in defining the CAMx ozone modeling domain:

- Placing a high-resolution (4 km) grid over the key monitors, sources and urban areas in Northeast Texas.
- The Northeast Texas 4 km grid must be large enough to include local and nearby major sources of emissions.
- The regional domain must extend far enough upwind to include all sources that might contribute substantially to elevated ozone levels in Northeast Texas. EPA's guidance (EPA, 1999) is that regional domains should account for potential transport distances of about 2 days upwind. Back trajectory analyses suggest that under high 8-hour ozone conditions in Northeast Texas 2-3 day back trajectories may extend as far as the Midwest.
- The ozone model (CAMx) grid must closely match the meteorological model (MM5) grid to minimize distortion of the meteorological variables in transferring data from MM5 to CAMx.

The ozone modeling domains are shown in Figures 5-1 and 5-2. The ozone modeling uses nested 36 km, 12km and 4 km grids. The 36 km grid extends as far as the Midwest to account for 2-3 days of potential regional transport. The 12 km grid includes all of the areas in eastern Texas that are conducting ozone modeling so that a consistent 12 km grid can be used in all studies. In addition, the 12 km grid includes areas that would be upwind of Texas during an ozone episode with easterly or northeasterly winds. The intention is to accurately model potential transport of ozone from areas at a distance upwind of about one State. The 4 km grid covers Northeast Texas and immediately adjacent major urban areas and major sources.

The vertical grid structure for the ozone model was selected based on EPA modeling guidance (EPA, 1999) that has the following recommendations on vertical layer structure:

- Use 7-9 layers in the planetary boundary layer (PBL, the daily maximum mixing depth)
- The surface layer should be no thicker than 50 m
- No layer within the Planetary Boundary Layer (PBL) should be thicker than 300 m
- Add 1 or 2 layers above the PBL.

The ozone modeling used 15 layers that exactly match the meteorological model layers up to approximately 4000 m above ground level. Under typical elevated ozone conditions in Northeast Texas the maximum depth of the PBL (i.e. mixing height) is about 1500-2000 m AGL. This means that modeling had about 10 layers within the typical maximum PBL, including a 20 m surface layer.

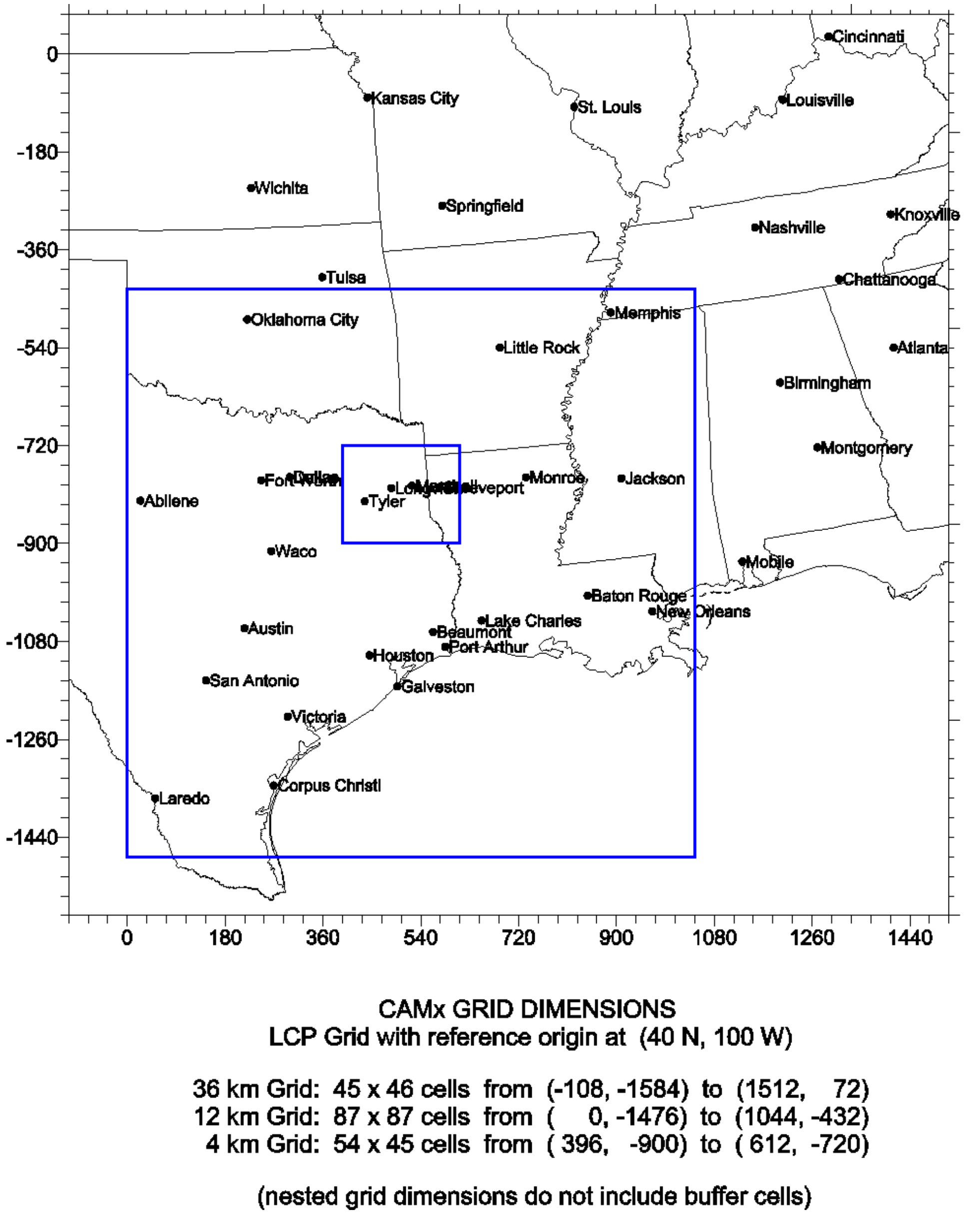


Figure 5-1. CAMx modeling domain for the August 1999 episode showing the 36 km regional grid and the nested 12 km and 4 km fine grids.

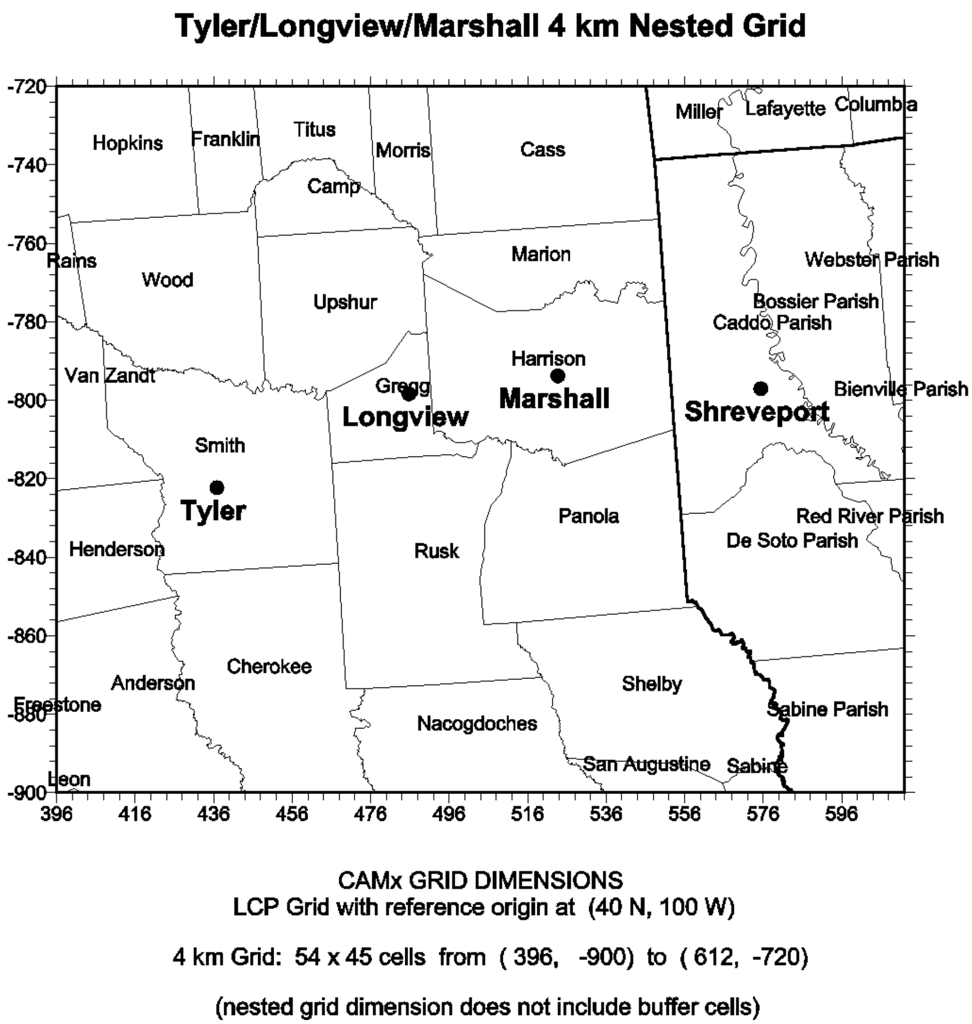


Figure 5-2. CAMx 4 km fine grid covering Northeast Texas for the August 1999 episode.

CHEMISTRY DATA

The CAMx "chemistry parameters" file determines which photochemical mechanism is used to model ozone formation. CAMx was run with an updated version of the Carbon Bond 4 mechanism (CB4), referred to as mechanism 3 in CAMx, which is described in the CAMx User's Guide (ENVIRON, 2002). Mechanism 3 is the CB4 mechanism with updated radical-radical termination reactions and updated isoprene mechanism as used for the OTAG modeling and other TCEQ modeling studies.

The chemistry parameters file specifies the rates for all of the "thermochemical" reactions in the CB4 mechanism. The CB4 mechanism also includes several "photolysis" reactions that depend upon the presence of sunlight. The photolysis rates input file determines the rates for chemical reactions in the mechanism that are driven by sunlight. Photolysis rates were calculated using the Tropospheric visible Ultra-Violet (TUV) model developed by the National Center for Atmospheric Research (Madronich, 1993 and 2002). TUV is a state-of-the-science solar radiation model that is designed for photolysis rate calculations. TUV accounts for environmental parameters that influence photolysis rates including solar zenith angle, altitude above the ground, surface UV albedo, aerosols (haze), and stratospheric ozone column.

The albedo/haze/ozone input file is used in conjunction with the photolysis rates input file to specify several of the environmental factors that influence photoloysis rates. The photolysis rates and albedo/haze/ozone files must be coordinated to function together correctly. The surface UV albedo was calculated based on the gridded land use data using the landuse specific UV albedo values given in Table 5-1. The albedo varies spatially according to the land cover distribution, but does not vary with time. The total ozone column was based on satellite data from the Total Ozone Mapping Spectrometer (TOMS), which are available from a web site maintained by the NASA Goddard Space Flight Center (http://jwocky.gsfc.nasa.gov). Daily ozone column are available at 1.25°longitude by 1° latitude resolution and were mapped to the CAMx grid. The haze optical depth was assumed to be 0.1.

Table 5-1. CAMx land use categories and the default surface roughness values (m) and UV albedo assigned to each category within CAMx.

Category Number	Land Cover Category	Surface Roughness (meters)	UV Albedo
1	Urban	3.00	0.08
2	Agricultural	0.25	0.05
3	Rangeland	0.05	0.05
4	Deciduous forest	1.00	0.05
5	Coniferous forest including wetland	1.00	0.05
6	Mixed forest	1.00	0.05
7	Water	0.0001	0.04
8	Barren land	0.002	0.08
9	Non-forested wetlands	0.15	0.05
10	Mixed agricultural and range	0.10	0.05
11	Rocky (with low shrubs)	0.10	0.05

INITIAL AND BOUNDARY CONDITIONS

The initial conditions (ICs) are the pollutant concentrations specified throughout the modeling domain at the start of the simulation. Boundary conditions (BCs) are the pollutant concentrations specified at the perimeter of the modeling domain throughout the simulation. The boundary condition assumptions are discussed because they played a role in achieving good ozone model performance. The boundary conditions are shown in Table 5-2. The ozone BC was set to 40 ppb, which is the value commonly considered to be the continental background and used for ozone modeling studies. The NOx BC was set to 1.1 ppb. The VOC BCs varied by boundary segment over a range from 9 to 50 ppbC according to broad differences in land cover. The higher VOC BCs in the Northeast/East boundary segment are for areas with higher biogenic emissions (Goldan et al., 1995; Watkins et al., 1995). The lower VOC BCs along the West boundary segment are for dryer areas with lower biogenic emissions. The lowest VOC BCs are over the Gulf of Mexico and these low values were also used for all boundaries above an altitude of 1700 m. The initial conditions throughout the modeling domain were set to the lowest (Gulf of Mexico) BC values.

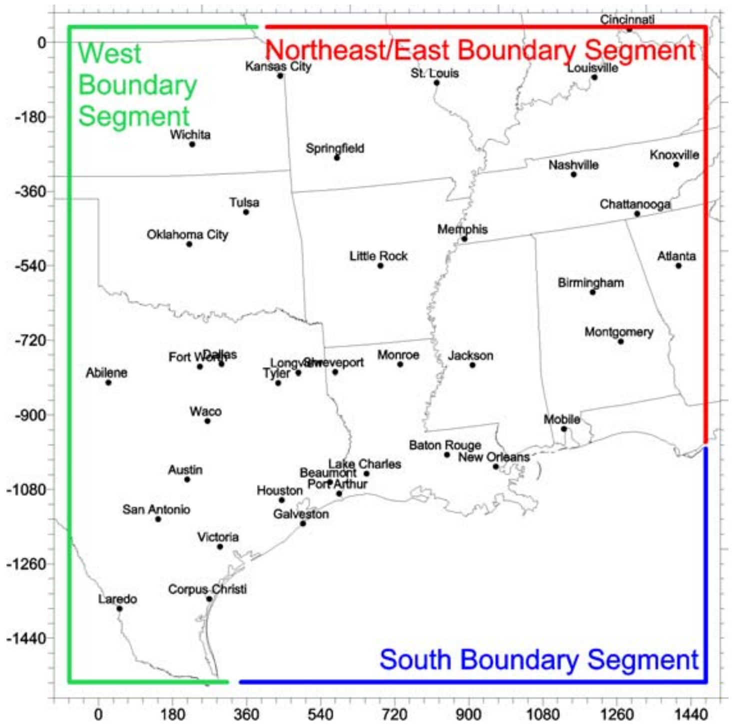


Figure 5-3. CAMx 36 km regional modeling domain showing boundary segments that are assigned different boundary conditions (BCs).

Table 5-2. Boundary concentrations for different boundary segments shown in Figure 5-3.

Species	East/Northeastern Boundary	Western Boundary	Southern Boundary
O3 (ppb)	40.0	40.0	40.0
NOx (ppb)	1.1	1.1	1.1
VOC (ppbC)	50.5	22.3	9.3

SURFACE CHARACTERISTICS (LANDUSE)

CAMx requires gridded landuse data to characterize surface boundary conditions, such as surface roughness, deposition parameters, vegetative distribution, and water/land boundaries. CAMx land use files provide the fractional contribution (0 to 1) of eleven land use categories (Table 5-2) to the surface area of grid cell.

Gridded land cover data were developed from the same landuse databases that were used in the generation of spatial emission surrogates (Yarwood et al., 2002). A program was written to re-cast the raw spatial surrogate data into the eleven CAMx land use categories, to grid the data to the 36, 12, and 4 km CAMx grids, and to write the results to a model-ready format. Figures 5-4 and 5-5 show the dominant land use category in each grid cell for the 36 km and 12 km grids, respectively. The dominant land use comprises the majority of surface cover in each cell and the "Forest" category is the sum of the three CAMx categories 4 to 6.

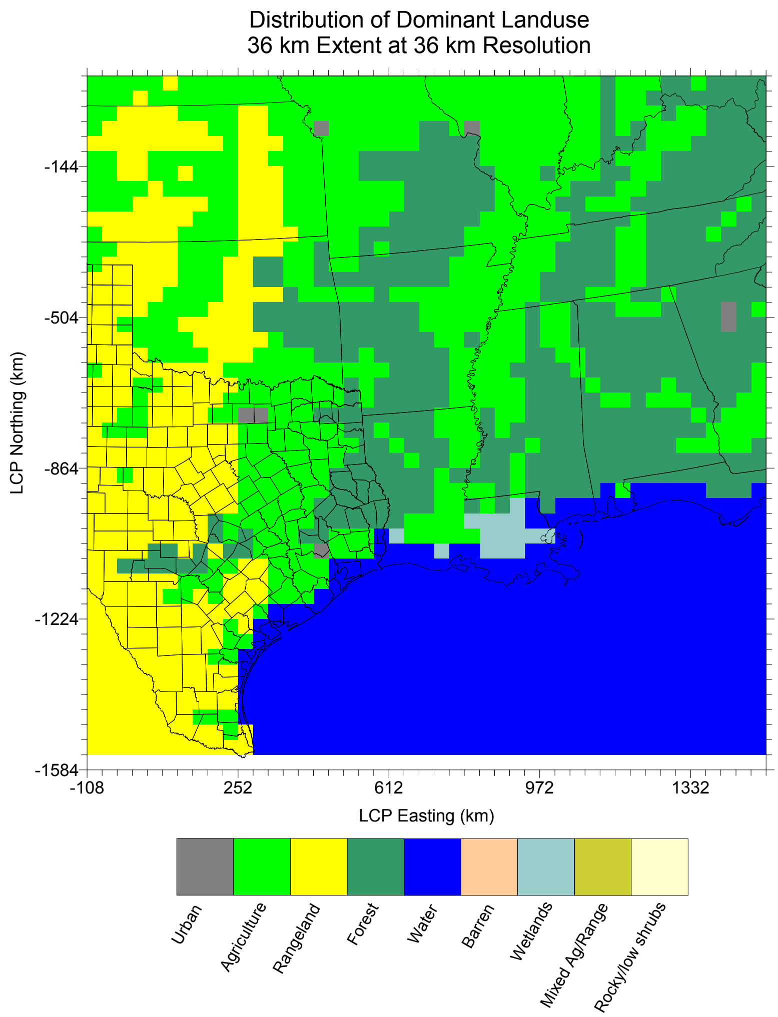


Figure 5-4. Distribution of the dominant land cover type in each grid cell of the 36-km CAMx grid.

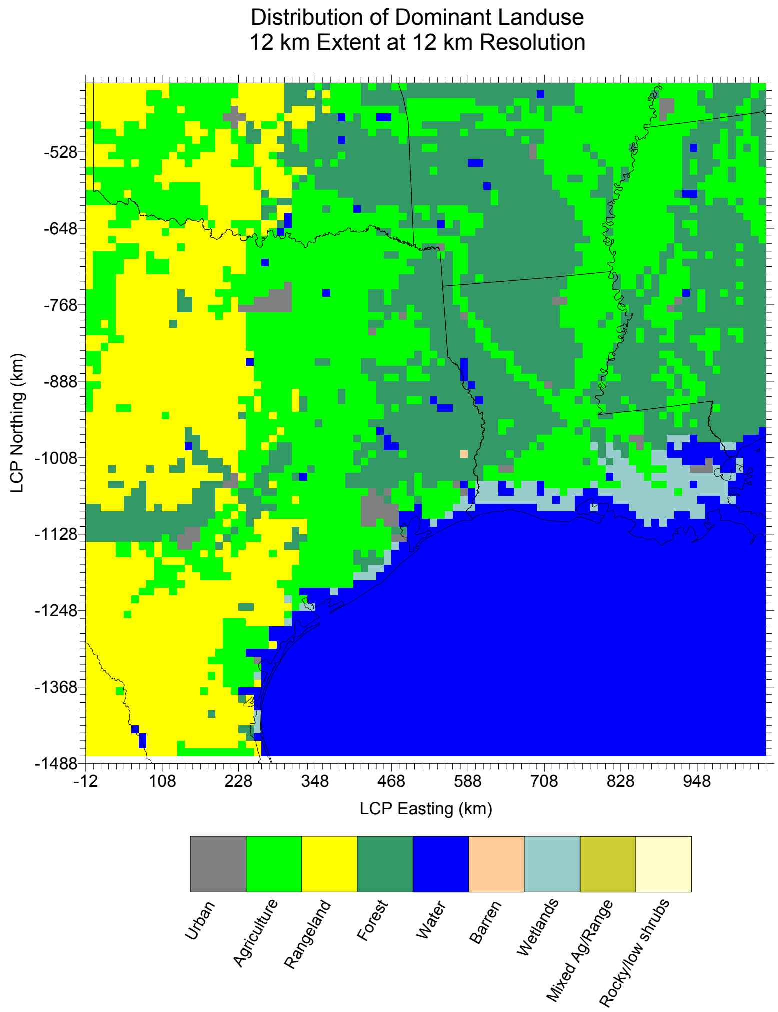


Figure 5-5. Distribution of the dominant land cover type in each grid cell of the 12-km CAMx grid.

CAMx MODEL OPTIONS

CAMx has several user-selectable options that are specified for each simulation through the CAMx control file. Most of these options follow naturally from other choices about model inputs. An example CAMx control script is shown in Figure 5-6. There are four model options that must be decided for each project: the choice of advection scheme, the plume-in-grid scheme, the chemical mechanism and the chemistry solver. The selection for each option is decided at the stage of the base case model performance evaluation and then held fixed for the evaluation of any future year emission scenarios. The recommended choices for these options are discussed below. See the CAMx User's Guide (ENVIRON, 2004) for more details on these options.

Advection Scheme

CAMx version 4.02 has three optional methods for calculating horizontal advection (the movement of pollutants due to resolved horizontal winds) called Smolarkiewicz, Bott and Piecewise Parabolic Method (PPM). The Smolarkiewicz scheme has been used for many years, and was used in the previous modeling for Northeast Texas (ENVIRON, 1999). The Smolarkiewicz scheme has been criticized for causing too much artificial diffusion of pollutants, tending to "smear out" features and artificially overstate transport. The Bott and PPM schemes are newer and have less artificial diffusion than the Smolarkiewicz scheme. The PPM scheme was used for this study as it has been determined to be the least numerically diffusive, runs at speeds similar to Smolarkiewicz, and does not exhibit certain "noisy" features near sharp gradients that are apparent with the Bott approach.

Plume-in-Grid

CAMx includes an optional sub-grid scale plume model that can be used to represent the dispersion and chemistry of major NOx point source plumes close to the source. We used the Plume-in-Grid (PiG) sub-model for major NOx sources. Selection of PiG sources was discussed in Section 3. The criteria for selecting NOx point sources for plume in grid treatment within the 4-km modeling domain is 2 tons NOx on any episode day. For the regional emissions grid, the NOx criteria is 25 tons per day on any episode day.

Chemical Mechanism

CAMx provides several two main alternatives for the chemical mechanisms used to describe the gas-phase chemistry of ozone formation, namely the Carbon Bond 4 (CB4) and SAPRC99 mechanisms. The most widely used mechanism for regional applications is CB4 with the updated isoprene and radical termination reactions, and CB4 was used for this study.

Chemistry Solver

CAMx has two options for the numerical scheme used to solve the chemical mechanism. The first option is the CMC fast solver that has been used in every prior version of CAMx. The second option is an IEH solver. The CMC solver is faster and more accurate than most chemistry solvers used for ozone modeling. The IEH solver is even more accurate than the CMC solver, but slower. Both solvers were used during this study and the final base case 7 used the CMC solver.

```
CAMx Version        |VERSION4.0
Run Message         |CAMx v4.0 base7 Aug 13-22 1999
Root output name    |../output/base7/camx.990816.base7
Start yr/mo/dy/hr   |1999 08 16    0.
End   yr/mo/dy/hr   |1999 08 16 2400.
dtmx,dtin,dtem,dtou|15. 60. 60. 60.
nx,ny,nz            |45  46  15
Coordinate ID       |LAMBERT
xorg,yorg,dx,dy     |-108. -1584. 36. 36. -100. 40. 60. 30.
time zone           |6
PiG parameters      |2000. 12.
Avg output species  |16
                    |NO        NO2       O3        PAR       TOL       ETH
                    |OLE       PAN       ISOP      XYL       FORM      ALD2
                    |HNO3      NXOY      NTR       CO
# nested grids      |2
nest grid params    | 4 32  4 32 15 3
nest grid params    |15 20 20 24 15 9
SMOLAR,BOTT, PPM?   |PPM
Chemistry solver    |CMC
Restart             |true
Chemistry           |true
Dry dep             |true
Wet dep             |true
PiG submodel        |true
Staggered winds     |true
Treat area emiss    |true
Treat point emiss   |true
1-day emiss inputs  |true
3-D average file    |false
Source Apportion    |false
Chemparam           |../input/other/CAMx4.chemparam.3
Photolysis rates    |../input/other/camx.etcog.rates.do
Landuse             |../input/other/CAMx.landuse.36km.lcp
Height/pressure     |../input/met/36km/camx.v4.zp.etcog.36km.990816.run6.bin.a0
Wind                |../input/met/36km/camx.v4.uv.etcog.36km.990816.run6.bin.a0
Temperature         |../input/met/36km/camx.v4.tp.etcog.36km.990816.run6.bin.a0
Water vapor         |../input/met/36km/camx.v4.qa.etcog.36km.990816.run6.bin.a0
Cloud/Rain          |../input/met/36km/camx.v4.cr.etcog.36km.990816.run6.bin.a0
Vertical diffsvty   |../input/met/36km/camx.v4.kv.etcog.36km.990816.run6.patch.bin.a0
Initial conditions  |
Boundary conditions|../preproc/icbc_dfw/bc.36km.4km15.segments.bin
Top concentration   |../preproc/icbc_dfw/tc.36km.4km15.segments
Albedo/haze/ozone   |../input/other/ahomap.v4.etcog.aug99.drought.227-233
Point emiss         |../eps2x/model_emiss/ptsrce.et3.pig.990816.a0
Area emiss          |../eps2x/model_emiss/emiss.surface.ET3_reg_36km.drought.990816.a1
Landuse          #1 |../input/other/CAMx.landuse.12km.lcp
Landuse          #2 |../input/other/CAMx.landuse.4km.buffered.lcp
Height/pressure  #1 |../input/met/12km/camx.v4.zp.etcog.12km.990816.run6.bin.a0
Height/pressure  #2 |../input/met/04km/camx.v4.zp.etcog.04km.990816.run6.bin.a0
Wind             #1 |../input/met/12km/camx.v4.uv.etcog.12km.990816.run6.bin.a0
Wind             #2 |../input/met/04km/camx.v4.uv.etcog.04km.990816.run6.bin.a0
Temperature      #1 |../input/met/12km/camx.v4.tp.etcog.12km.990816.run6.bin.a0
Temperature      #2 |../input/met/04km/camx.v4.tp.etcog.04km.990816.run6.bin.a0
Water vapor      #1 |../input/met/12km/camx.v4.qa.etcog.12km.990816.run6.bin.a0
Water vapor      #2 |../input/met/04km/camx.v4.qa.etcog.04km.990816.run6.bin.a0
Cloud/Rain       #1 |../input/met/12km/camx.v4.cr.etcog.12km.990816.run6.bin.a0
Cloud/Rain       #2 |../input/met/04km/camx.v4.cr.etcog.04km.990816.run6.bin.a0
Vertical diff    #1 |../input/met/12km/camx.v4.kv.etcog.12km.990816.run6.patch.bin.a0
Vertical diff    #2 |../input/met/04km/camx.v4.kv.etcog.04km.990816.run6.patch.bin.a0
Area emiss       #1 |../eps2x/model_emiss/emiss.surface.ET3_reg_12km_wbuf.drought.990816.a1
Area emiss       #2 |../eps2x/model_emiss/emiss.surface.ET3_4km_wbuf.drought.990816.a0
coarse restart      |../output/base7/camx.990815.base7.inst.2
fine   restart      |../output/base7/camx.990815.base7.finst.2
PiG    restart      |../output/base7/camx.990815.base7.pig
```

Figure 5-6. Example CAMx control script for August 16th, 1999 of Base Case 7.

6. OZONE MODELING

The ozone modeling for the Northeast Texas early action compact (EAC) followed the EPA's draft guidance for 8-hour ozone modeling (EPA, 1999). The modeling procedures were established in a modeling protocol (ENVIRON, 2003). This section describes the modeling results, 8-hour ozone model performance evaluation and the 8-hour ozone attainment demonstration for 2007.

OVERVIEW OF THE OZONE MODELING

The ozone modeling began with developing a "base case" for the August 13-22, 1999 modeling period. Base case model performance was carefully evaluated to determine how well the modeling replicated observed ozone levels. The model performance evaluation compared the modeled and observed ozone levels and also considered whether the modeling was getting the right answer for the right reasons. Model sensitivity and diagnostic tests were an important tool for understanding the base case model performance and guiding efforts to correct specific problems that were hindering model performance.

NETAC began developing an ozone model for the August 1999 episode before entering into the EAC, which allowed time for extensive model development and evaluation as described in a previous NETAC ozone modeling report (Yarwood et al., 2003). The ozone model development prior to the EAC led to a 1999 base case called "base5." The development activities leading to base5 are summarized below including the results of numerous diagnostic and sensitivity tests.

A new base case (base7) was developed for the EAC modeling using updated emission inventories, improved boundary conditions (BCs) and an updated version of the ozone model (CAMx version 4.02). The base7 model performance evaluation is described below. Model performance with base7 was evaluated in accordance with EPA's guidance (EPA, 1999) and base7 was found to be appropriate for developing an 8-hour ozone attainment demonstration.

The 8-hour attainment demonstration relied upon estimating the 8-hour ozone design value for Northeast Texas in 2007. The projected 2007 8-hour design value must be below the level of the 8-hour ozone standard (i.e., 84 ppb or lower) for the area to be modeling attainment of the 8-hour standard. The 2007 design value was projected from base year modeling for 2002 combined with observed 2001-2003 design values. The NETAC Technical Committee selected a base year of 2002 for the attainment demonstration, with approval from the EPA and TCEQ, for the following reasons:

- EPA is using the 2001-2003 design values to determine the attainment status for Northeast Texas under the 8-hour ozone standard.
- There have been substantial emissions reductions in Northeast Texas since the August 15-22, 1999 ozone episode, and these have been accompanied by a decline in 8-hour ozone design values.
- Using the most recent emissions (2002) and air quality data (2001-2003) results in less extrapolation in projecting 2007 Design Values than if older emissions/air quality data are used.

The attainment demonstration modeling showed that Northeast Texas expects to remain in attainment of the 8-hour ozone standard in 2007 with existing control measures developed by NETAC, the State of Texas and the EPA.

The ozone modeling and attainment demonstration are described in the remainder of this section. Several appendices provide additional detail on ozone modeling results:

Appendix A: Spatial Maps of Estimated and Observed Daily Maximum 8-Hour Ozone (ppb) in the 4-km Grid for the August 15–22, 1999 Episode: 1999 Base Case 7

Appendix B: Spatial Maps of Estimated Daily Maximum 8-Hour Ozone (ppb) in the 12-km Grid for the August 15-22, 1999 Episode: 1999 Base Case 7

Appendix C: Spatial Maps of Estimated Daily Maximum 8-Hour Ozone (ppb) in the 4-km Grid for the August 15–22, 1999 Episode: 2002 Base Case 3

Appendix D: Spatial Maps of Estimated Daily Maximum 8-Hour Ozone (ppb) in the 4-km Grid for the August 15–22, 1999 Episode: 2007 Base Case 5

Appendix E: Time Series of Estimated and Observed 1-Hour and 8-Hour Ozone (ppb) for AIRS Monitors in the 4-km Grid for the August 15-22, 1999 Episode: 1999 Base Case 7

Appendix F: Time Series of Estimated and Observed 1-Hour Ozone (ppb) for AIRS Monitors in the 12-km Grid for the August 15-22, 1999 Episode: 1999 Base Case 7

Appendix G: Scatter Plots of Estimated and Observed 1-Hour Ozone (ppb) for AIRS Monitors in the 4-km Grid for the August 15-22, 1999 Episode: 199 Base Case 7

Appendix H: Scatter Plots and Quantile-Quantile Plots of Daily Maximum 1-Hour Ozone (ppb) for AIRS Monitors in Northeast Texas for the August 15-22, 1999 Episode: 1999 Base Case 7

Appendix I: Model Performance Statistics for 1-Hour Ozone (ppb) for AIRS Monitors in the 4-kim Grid for the August 15-22, 1999 Episode: 1999 Base Case 7

Appendix J: Scatter Plots of Estimated and Observed 8-Hour Ozone (ppb) for AIRS Monitors in the 4-km Grid for the August 15-22, 1999 Episode: 1999 Base Case 7

Appendix K: Quantile-Quantile Plots of 8-Hour Ozone (ppb) for AIRS Monitors in the 4-km Grid for the August 15-22, 1999 Episode: 1999 Base Case 7

Appendix L: Model Performance Statistics for 8-Hour Ozone (ppb) for AIRS Monitors in Northeast Texas for the August 15-22, 1999 Episode: 1999 Base Case 7

INITIAL 1999 BASE CASE MODELING

Base Cases 1 through 5

Initial development of a 1999 base case is described in Yarwood et al. (2003) and culminated in a base case called "base5." All of the ozone modeling up to base5 used CAMx version 3.1 with older emission inventories (e.g., on-road emissions from MOBILE5, off-road emissions from an older version of NONROAD). The results of runs base1 through base5 are summarized below followed by a summary of the diagnostic tests completed with base2 and the emissions sensitivity tests completed with base3. The most persistent model performance issue encountered with runs base1 to base5 was a tendency to under predict the regional background of ozone being transported into the 4-km grid over Northeast Texas. Another problem with some simulations was a tendency to predict unrealistically high peak ozone levels within the 4-km grid. A series of improvements to the meteorological input fields developed using MM5 improved both of these aspects of the ozone model performance. The updates to the MM5 modeling are discussed in section 4. However, a tendency to under predict the regional background of ozone being transported into the 4-km grid remained in base5.

Base1. The first CAMx base case used meteorology from MM5 run 3b. Close examination of the vertical mixing predictions from run 3b showed unrealistic geographic variations in mixing that were determined to be artifacts of the Gayno-Seaman PBL scheme used in run 3b.

Base2. A new MM5 simulation (run 5) was completed that used the same MM5 configuration as run 3b but replaced the Gayno-Seaman PBL scheme with the Blackadar PBL scheme. CAMx base case 2 used MM5 run 5 and showed a tendency to under predict ozone in the 4-km and 12-km grids on all days. A series of diagnostic tests was performed with base2, as described below.

Base3. CAMx base case 3 used MM5 meteorology from a new run (run5b) and CAMx changes selected from the base case 2 diagnostic tests (discussed below). The MM5 radiation transfer scheme was changed to "RRTM" in run5b from the "Cloud Radiation Scheme" used in MM5 run5 and run3b. The RRTM scheme improved performance for surface temperatures and had relatively little impact on other parameters (winds, mixing, etc.). Other changes between base case3 and base case 2 were: (1) Increasing the number of CAMx vertical layers from 12 to 15, including a 20 m deep surface layer; (2) Using the more accurate IEH chemistry solver, and; (3) Modifying the dry deposition to account for drought stress. Base case 3 showed fewer tendencies toward ozone under-prediction (as shown by improved bias statistics) but unrealistically high ozone levels in the 4-km grid accompanied this improvement. A series of emissions tests was performed with base3, as described below.

Base4. CAMx base case 4 evaluated the impacts of the Texas Eastman emission inventory updates recommended after base3. The emission inventory updates had little impact on maximum ozone levels.

Base5. The changes between base5 and base3 were: (1) Updated the meteorology to MM5 run 6 which had the Pleim-Xiu boundary layer and land surface scheme, revised data assimilation methodology and a larger 36-km MM5 grid; (2) Changed the Shreveport off-road and area source emissions from Louisiana DEQ data to EPA NEI data; (3) Updated the Texas Eastman emission inventory from version 6b to version 12b of the TCEQ PSDB. Model performance with base5 was improved over previous base cases and base5 was used as the starting point for preliminary 2007 modeling. However, a tendency to under predict the regional background of ozone being transported into the 4-km grid remained in base5.

Diagnostic Tests with Base Case 2

A series of model sensitivity and diagnostic tests was performed to investigate relationships between model performance, model input data and model configuration. The diagnostic and sensitivity tests completed with base2 are described in Tables 6-1 and 6-2. Tests diag1 - diag4 were identified in the modeling protocol. The other tests were chosen to investigate potential causes for ozone under prediction in the 4-km grid. These tests resulted in improvements to the meteorology (from MM5) and the boundary conditions.

Table 6-1. CAMx diagnostic simulations performed starting from base case 2.

Run	Description	Conclusion
Base2	Base case 2	Tendency to under predict 4-km grid ozone levels by ~10 ppb on average
diag1	Base2 with zero anthropogenic emissions	Ozone levels were much lower without anthropogenic emissions
diag2	Base2 with 30% cut in biogenic emissions	Reducing biogenic VOCs resulted in lower ozone levels
diag3	Base2 with high 36 km grid boundary conditions (Ozone = 60 ppb rather than 40 ppb)	20 ppb higher ozone BCs increased ozone in the 4-km grid by about 15 ppb
diag4	Base2 with no plume in grid option	Small ozone sensitivity in 4-km grid
diag5	Base2 with sensitivity Kvs. A Kv profile was prescribed for the 4-km grid that gave a maximum PBL depth of 1500 m	Moderate ozone sensitivity in 4-km grid but no systematic improvement in ozone bias
diag6	Base2 with drought stress effects on dry deposition rates	Lower deposition rates lessened the ozone under prediction bias
diag7	Base2 using the more accurate chemistry solver option (IEH rather than CMC)	IEH solver slightly reduces ozone under prediction bias. Model run times were doubled.
diag8	diag7 with higher CAMx top (~10 km rather than ~4-km) and every MM5 layer mapped directly to CAMx (23 layers rather than 12)	Runs diag8 - diag12 systematically investigated sensitivity to CAMx layer structure and model top. Several runs were needed to separate confounding effects. Raising the model top from 4-km to 10-km had little impact on surface ozone levels. Using more layers had some impact, tending to raise daytime ozone and lower nighttime ozone. This effect was mainly due to lowering the surface layer thickness from 40 m to 20
diag9	diag7 with higher CAMx top (~10 km) and 15 layers in CAMx	
diag10	diag7 with higher CAMx top (~6 km) and 13 layers in CAMx	

Run	Description	Conclusion
diag11	diag8 with longer timesteps (CFL number increased to 0.9 from 0.5) to determine whether timesteps were the difference between diag7 and diag8	m. The change in model timesteps associated with raising the model top from 4-km to 10-km was investigated in diag11 and found to be unimportant.
diag12	diag7 with original CAMx top (~4 km) and every MM5 layer mapped directly to CAMx (15 layers rather than 12)	

Table 6-2. Peak 1-hour ozone levels in the NETAC area for base case 2 and related diagnostic tests.

Date	15-Aug	16-Aug	17-Aug	18-Aug	19-Aug	20-Aug	21-Aug	22-Aug
Observed peak 1-hour ozone in Northeast Texas (ppb)								
Observed	95	124	134	91	101	99	107	107
Modeled peak 1-hour ozone in Northeast Texas (ppb)								
base2	77	122	129	125	122	86	90	105
diag1	31	35	33	29	30	24	30	32
diag2	74	109	113	116	111	85	85	96
diag3	84	128	136	128	126	90	95	110
diag4	77	122	129	127	123	86	91	106
diag5	74	107	126	129	133	87	87	105
diag6	85	130	137	132	133	98	99	114
diag7	78	122	130	126	124	87	91	106
diag8	78	119	127	127	122	89	90	106
diag9	78	119	125	126	124	88	90	106
diag11	82	123	131	129	129	91	91	108
diag12	79	123	136	129	129	88	91	106
Difference in modeled 1-hour peak ozone from base2 (ppb)								
diag1	-46.5	-86.6	-96.1	-95.9	-91.9	-62.8	-60.1	-72.6
diag2	-3.0	-12.1	-16.0	-8.5	-11.2	-1.3	-5.0	-8.4
diag3	6.9	6.4	6.8	3.2	3.2	3.1	4.4	5.2
diag4	-0.3	0.2	0.2	2.4	0.5	-0.3	0.4	0.8
diag5	-3.2	-14.7	-2.9	3.7	10.7	0.5	-2.8	0.0
diag6	7.6	8.5	7.9	7.2	10.3	11.2	8.4	9.0
diag7	0.7	0.7	0.8	1.5	1.2	0.5	0.7	1.2
diag8	1.1	-3.0	-1.2	2.2	0.0	2.8	-0.5	1.3
diag9	0.9	-2.8	-3.5	1.2	1.9	1.2	-0.2	1.2
diag11	4.2	1.5	2.7	4.2	6.8	4.6	1.0	3.5
diag12	1.6	0.9	6.8	4.3	6.2	1.6	0.6	1.3

Emissions Sensitivity Tests with Base Case 3

A series of emissions sensitivity tests was conducted with base3 to characterize the response of ozone to emissions changes. The tests and the results are summarized in Tables 6-3 and 6-4.

The emissions sensitivity tests applied across the board 50% cuts to anthropogenic emissions from different sources. Biogenic emissions were not cut because biogenic emissions are considered non-controllable. A 50% reduction level was used in all cases to provide a simple basis for comparison, but this does not mean that feasible strategies exist to provide 50% reductions for all source types. Tests sens6a to sens6d reduced emissions across the entire modeling domain, whereas sens7d reduced emissions in just the 4-km grid. Comparing the results of sens7a and sens6a indicates the importance of reducing local emissions (i.e., within the 4-km grid) versus more distant emissions.

The impacts of the sensitivity tests on maximum 1-hour ozone levels in Northeast Texas area are summarized in Table 6-4. The relative effects of the emissions sensitivities on 8-hour ozone were similar to 1-hour ozone and are not shown here.

Table 6-3. Summary emissions sensitivity tests starting from base case 3.

Test	Description	Impact on peak 1-hour ozone
Sens6a	50% cut in all anthropogenic emissions.	Peak ozone levels reduced 21 to 37 ppb, depending upon the day.
Sens6b	50% cut in anthropogenic VOC emissions.	Peak ozone levels reduced 0 to 6 ppb, depending upon the day. VOC reductions ineffective (less than 3 ppb reduction) on all days but August 16th and 17th.
Sens6c	50% cut in anthropogenic surface NOx emissions.	Peak ozone levels reduced 6 to 18 ppb, depending upon the day. Surface NOx reductions effective on all days.
Sens6d	50% cut in elevated point NOx emissions.	Peak ozone levels reduced 4 to 17 ppb, depending upon the day. Elevated point NOx reductions effective on all days.
Sens7a	50% cut in all anthropogenic emissions outside the 4-km grid.	Peak ozone levels reduced 2 to 8 ppb, depending upon the day. Reduction greater than 3 ppb on only two days, August 20th and 23rd.

Table 6-4. Peak 1-hour ozone levels in the NETAC area for base case 3 and related sensitivity tests.

Date	15-Aug	16-Aug	17-Aug	18-Aug	19-Aug	20-Aug	21-Aug	22-Aug
Observed peak 1-hour ozone in Northeast Texas(ppb)								
Observed	95	124	134	91	101	99	107	107
Modeled peak 1-hour ozone in Northeast Texas (ppb)								
base3	83	131	147	130	150	97	100	116
sens6a	62	104	117	100	113	67	73	92
sens6b	83	128	141	128	148	97	100	115
sens6c	72	120	136	112	134	78	86	110
sens6d	79	123	138	124	135	90	94	100
sens7a	81	129	144	126	148	89	97	112
Difference in modeled 1-hour peak ozone from base case 3 (ppb)								

Date	15-Aug	16-Aug	17-Aug	18-Aug	19-Aug	20-Aug	21-Aug	22-Aug
Observed peak 1-hour ozone in Northeast Texas(ppb)								
sens6a	-21	-27	-30	-29	-37	-30	-27	-25
sens6b	0	-4	-6	-2	-2	0	0	-1
sens6c	-11	-11	-11	-18	-15	-18	-14	-6
sens6d	-4	-8	-10	-6	-14	-7	-6	-17
sens7a	-2	-2	-3	-3	-2	-8	-3	-5

The conclusions from the base case 3 emissions sensitivity tests are:

- Emissions reductions in the 4-km grid are much more effective than reductions outside the 4-km grid in reducing ozone in Northeast Texas.
- Reductions in NOx are much more effective than reductions in VOC in reducing peak ozone in Northeast Texas.
- Two days showed some sensitivity to VOC reduction, namely August 16th and 17th. These are days when the peak modeled ozone was very close to CAMS19 and Texas Eastman. However, NOx reduction is still more effective than VOC reduction on these days.
- Reductions in both surface and elevated point source NOx are effective in reducing ozone in Northeast Texas.

FINAL 1999 BASE CASE – BASE7

The final 1999 base case for the Northeast Texas EAC modeling was called "base7." Run base7 was developed directly from run base5 with the following changes:

- Changed the version of CAMx from 3.1 to 4.02.
- Improved the methodology for applying a drought stress adjustment in the calculation of dry deposition velocities to apply a specific adjustment for each grid cell using the same gridded drought index as in the biogenic emissions calculation (see section 3).
- New emission inventories based on MOBILE6.2, NONROADv2002, NEI version 2 and GloBEIS3.1 biogenic emissions with drought stress adjustment (see section 3).
- New boundary conditions (BCs) that are different for the Gulf of Mexico, higher biogenic emission areas in the eastern U.S. and lower biogenic emission areas in the central/western U.S. (see section 5).

The new boundary condition (BC) files used in base7 did not change the ozone levels on the boundaries (40 ppb) from base5. The new BC files did increase the ozone precursor levels, especially for VOCs along the eastern boundary segment in high biogenic emissions areas which were raised from ~9 ppbC in base5 to ~50 ppbC in base7. Raising the precursor levels in the BCs improved model performance in base7 by lowering the tendency to under predict regional ozone levels transported into the 4-km grid.

CAMx run base7 used the same meteorology as run base 5 (i.e., from MM5 run 6). CAMx run base 6 is not discussed here because it was the same as base7 except for having a preliminary on-road mobile source emission inventory.

MODEL PERFORMANCE EVALUATION

The performance of the ozone modeling for 15-22 August 1999 was evaluated according to EPA's draft guidance for 8-hour ozone modeling (EPA, 1999). This guidance suggests several methods that can be used to evaluate the performance of air quality models and in some cases suggest performance goals. In general, the draft 8-hour guidance differs from earlier EPA modeling guidance by encouraging use of a variety of evaluation methods to seek good performance for the right reasons as opposed to establishing a few rigid criteria. NETAC used several graphical and statistical methods to evaluate performance as listed below.

Graphical Performance Evaluation Methods:

- Isopleth plots of predictions and observations
- Time-series plots of predictions and observations
- Scatter plots of predictions and observations
- Quantile-quantile (Q-Q) plots of predictions and observations

Statistical Performance Evaluation Methods:

- Normalized bias for prediction/observation pairs (goal within 15%)
- Fractional bias for prediction/observation pairs
- Normalized gross error predictions and observations (goal within 35%)
- Fractional gross error predictions and observations
- Peak prediction and observation (goal within 20%)
- Correlation coefficient from prediction/observation scatter plots (goal moderate to large positive correlations)
- Bias in predicted/observed daily maximum near each monitor (goal within 20% at most monitors).

The bias and error statistical measures are defined as follows:

$$\textit{Normalized Bias} = 100\left(\frac{1}{N}\right)\sum (E_{tl} - O_{tl})\,/\,O_{tl}$$

$$\textit{Fractional Bias} = 100\left(\frac{1}{N}\right)\sum 2(E_{tl} - O_{tl})\,/\,(E_{tl} + O_{tl})$$

$$\textit{Normalized Gross Error} = 100\left(\frac{1}{N}\right)\sum |E_{tl} - O_{tl}|\,/\,O_{tl}$$

$$\textit{Fractional Gross Error} = 100\left(\frac{1}{N}\right)\sum 2|E_{tl} - O_{tl}|\,/\,(E_{tl} + O_{tl})$$

Where O_{tl} and E_{tl} are, respectively, the observed and estimated ozone concentration at site l and time t (i.e., matched by time and location).

Graphical Evaluation

Modeled daily maximum 8-hour ozone levels for the regional 12-km grid are shown for August 17th by the colored shading in Figure 6-1. This day is at the heart of the ozone episode in Northeast Texas and the figure shows high ozone levels covering northern Texas, northern Louisiana and southern Arkansas due to regional weather stagnation. The highest modeled ozone levels are in Northeast Texas because this is near the center of the stagnation allowing local anthropogenic and biogenic emissions to interact under conditions that are conducive to ozone formation. Ozone production within Northeast Texas combined with the regional background lead to the high ozone levels modeled in the region on August 17th and following days. This pattern is consistent with the conceptual model for high 8-hour ozone episodes in Northeast Texas in general and the 15-22 August 1999 ozone episode in particular. Similar figures for other episode days are included in Appendix B.

The modeled and observed daily maximum 8-hour ozone levels for the 4-km grid are shown in Figure 6-2 for the 16th, 17th, 18th and 22nd August 1999 (other days are included in Appendix A). The colored shading shows the modeled ozone and monitored values are shown as numbers. The model has a tendency to under predict the observed maximum ozone levels on August 16th at both the upwind monitors (Cypress River and Shreveport) and Longview/Tyler suggesting the background ozone transported into Northeast Texas may be too low in the model. The modeled and observed ozone levels agree better on August 17th and 18th when the modeling does not tend to under predict ozone. On August 22nd the modeled maximum ozone levels at Tyler and Longview agree well with the observed values but at the upwind monitors (Cypress River and Shreveport) the modeling under predicts the maximum ozone levels again suggesting that the background ozone transported into Northeast Texas may be too low in the model.

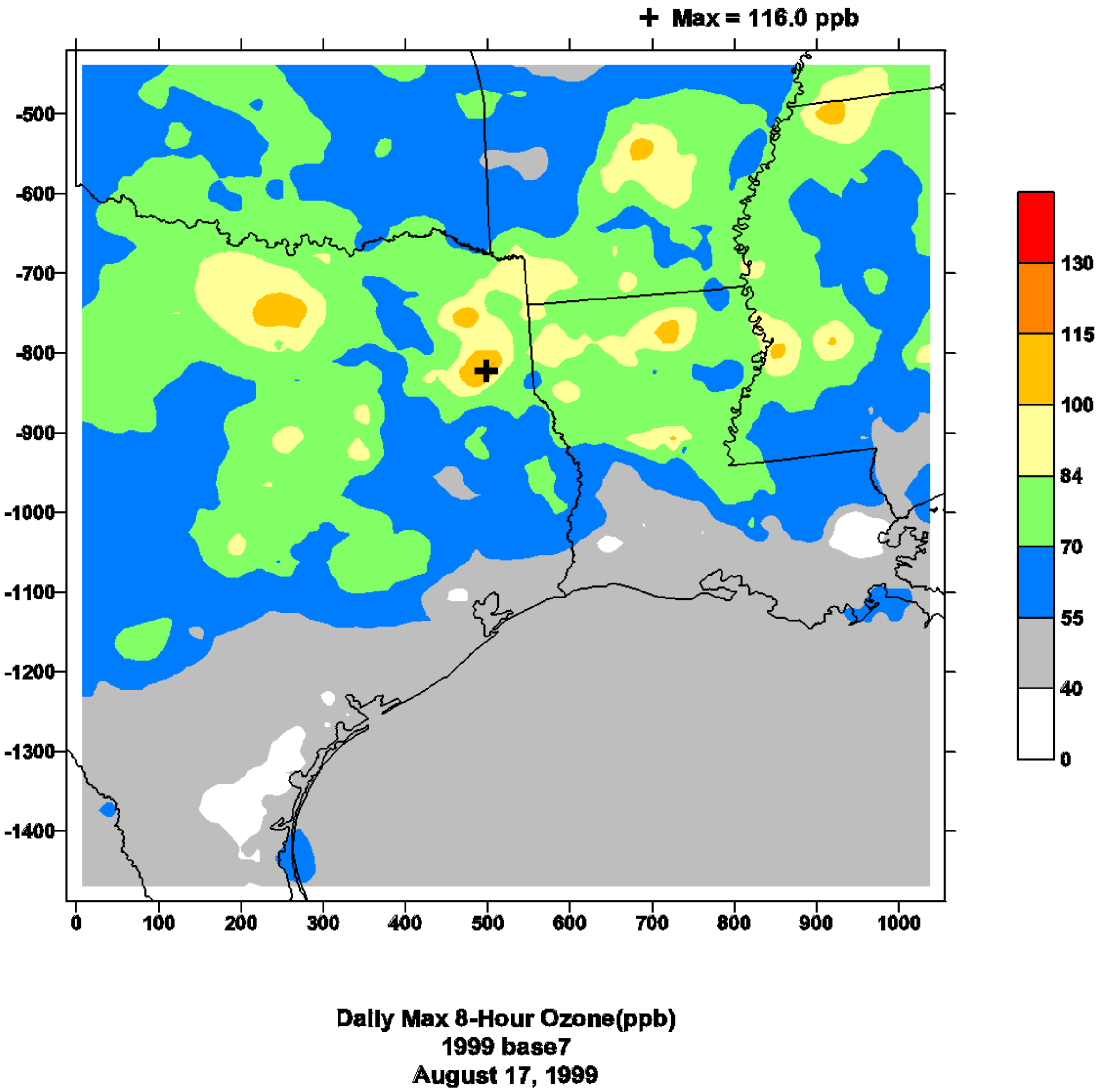


Figure 6-1. Daily maximum 8-hour ozone (ppb) for the 12-km grid on 17 August 1999.

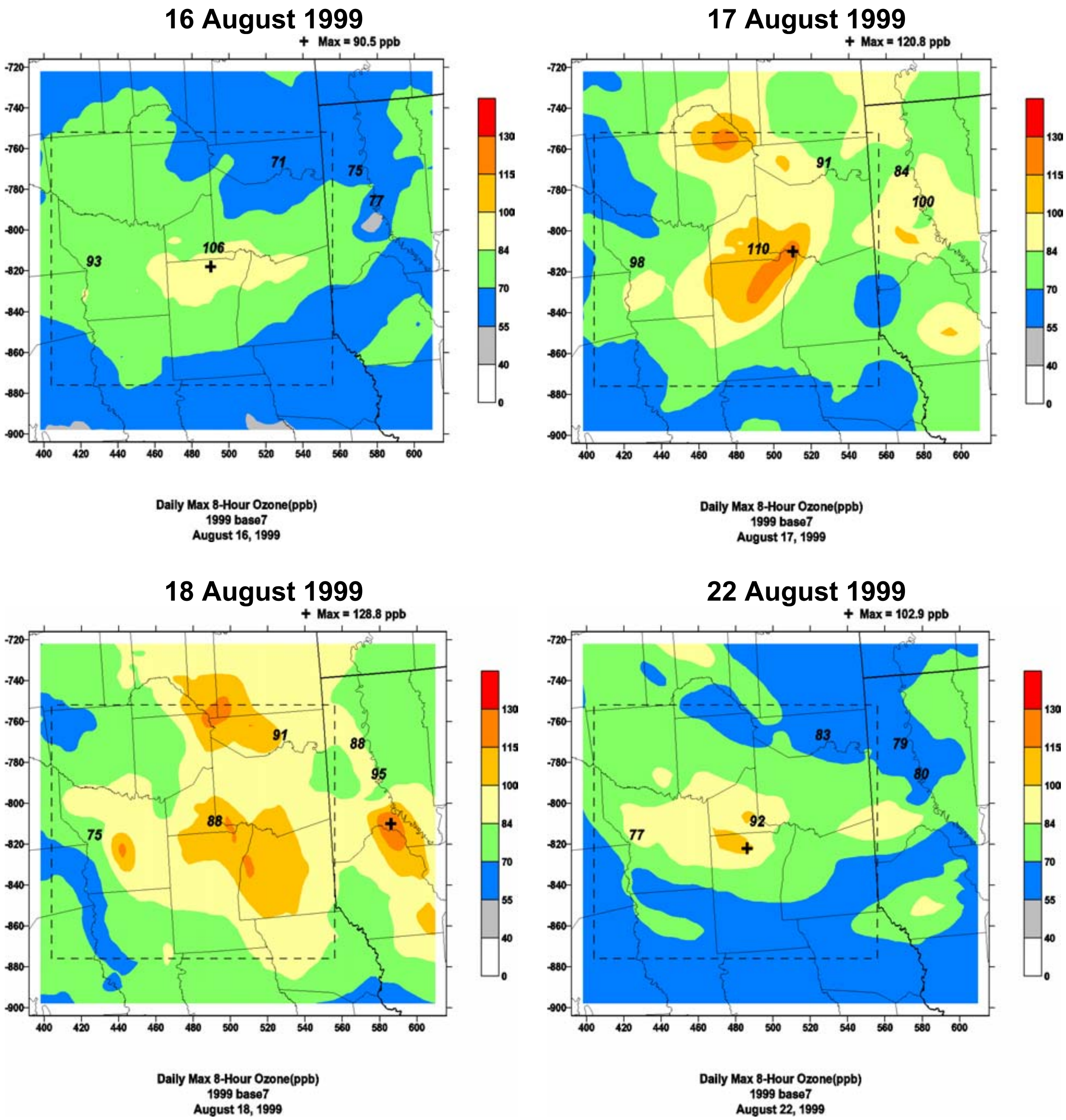


Figure 6-2. Daily maximum 8-hour ozone (ppb) for the 4-km grid.

The model performance features for the 4-km grid discussed above also are shown in the time series of 8-hour ozone shown in Figure 6-3. In addition, the time series show that the model performs well in predicting the timing of the daily peak ozone levels. The largest differences in the time series occur at night, especially at the rural Cypress River monitor during the heart of the episode. These differences are not problematic since it can be difficult to obtain good nighttime model performance because limited atmospheric mixing at night means that monitors can be influenced by localized conditions that are not resolved at 4-km grid resolution. Time series of 1-hour ozone are included in Appendix E for the 12-km grid and Appendix F for the 4-km grid.

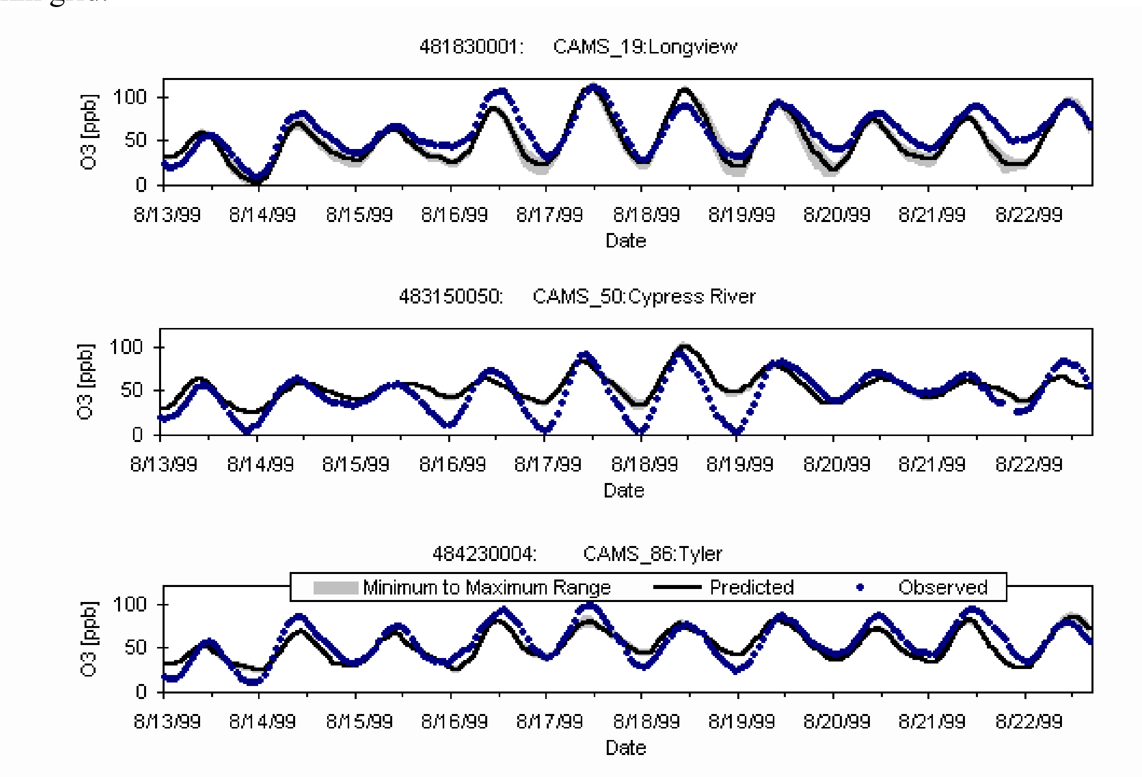


Figure 6-3. Time series of 8-hour ozone (ppb) for monitors in Northeast Texas.

Statistical Evaluation

Several model performance statistics were calculated from the data shown in Figure 6-3 for monitors in Northeast Texas and the statistical measures are shown in Table 6-5. The normalized bias indicates whether there was a tendency to over or under predict observed ozone concentrations greater than 60 ppb at monitor locations on each day. There is an under prediction bias on all days except August 18th but the bias is within the EPA goal on 6 of 8 days. The accuracy of the peak indicates whether there was a tendency to over or under predict the highest observed ozone concentrations on each day. The observed peak was over predicted on 6 of 8 days and was outside the EPA goal of 20% on two days. Taken together with the conclusions from the Figure 6-3 isopleth plots discussed above, these results indicate that the negative bias results from too little ozone transport into Northeast Texas rather than a lack of local ozone production. The normalized gross error describes the level of agreement between the modeled and observed ozone at the monitor locations and the gross error values shown in Table 6-5 are well within the EPA performance goal on all days.

Table 6-5. Model performance statistics for 8-hour ozone for monitors in Northeast Texas.

CAMx 8-Hour O3 Summary Statistics		Run = base7						Cutoff = 60ppb	
	EPA Goal	08/15	08/16	08/17	08/18	08/19	08/20	08/21	08/22
Number of valid pairs		13	33	35	28	36	32	34	33
Normalized Bias (%)	< +/-15	−8.6	−18.5	−6.4	14.0	−5.2	−13.3	−20.4	−3.9
Normalized Gross Error (%)	< 35	8.6	18.5	10.0	14.2	8.9	13.3	20.4	10.8
Peak Observed (ppb)		73.0	105.6	110.1	91.0	91.9	86.1	92.9	91.9
Peak Predicted (ppb)		78.1	90.5	120.8	121.3	117.9	98.2	90.9	102.9
Accuracy of Peak (%)	< +/-20	6.9	−14.3	9.7	33.3	28.3	14.0	−2.1	12.0

Some of the negative bias values shown in Table 6-5 may result from spatial miss-matches between the locations of modeled and observed high ozone. EPA's draft 8-hour modeling guidance (EPA, 1999) introduced some new graphical and statistical comparisons that focus on ozone "near" the monitoring locations. The same definition of "near" is used for these new comparisons as for the attainment demonstration methodology and so the new comparisons evaluate the modeling in the way that it will be used. When using a 4-km grid, near the monitor is defined as a block of 7 by 7 grid cells centered on the monitor location.

Figure 6-4 shows a scatter plot of nearest observed and predicted 8-hour ozone (ppb) near monitor locations in Northeast Texas. This figure includes several performance evaluation methods:

- The scatter plot of predicted/observed pairs (blue diamonds) shows values centered on the 1:1 line with no clear tendency toward over or under prediction.
- The predicted/observed values all lay within 20% of the 1:1 line meeting the goal.
- The correlation coefficient (r^2) for the scatter plot of predicted/observed pairs is 0.76, which meets the goal of a moderate to large positive correlation.
- The Quantile-Quantile plot (circles) lays very close to the 1:1 line showing that the observations and predictions have similar distributions of values.

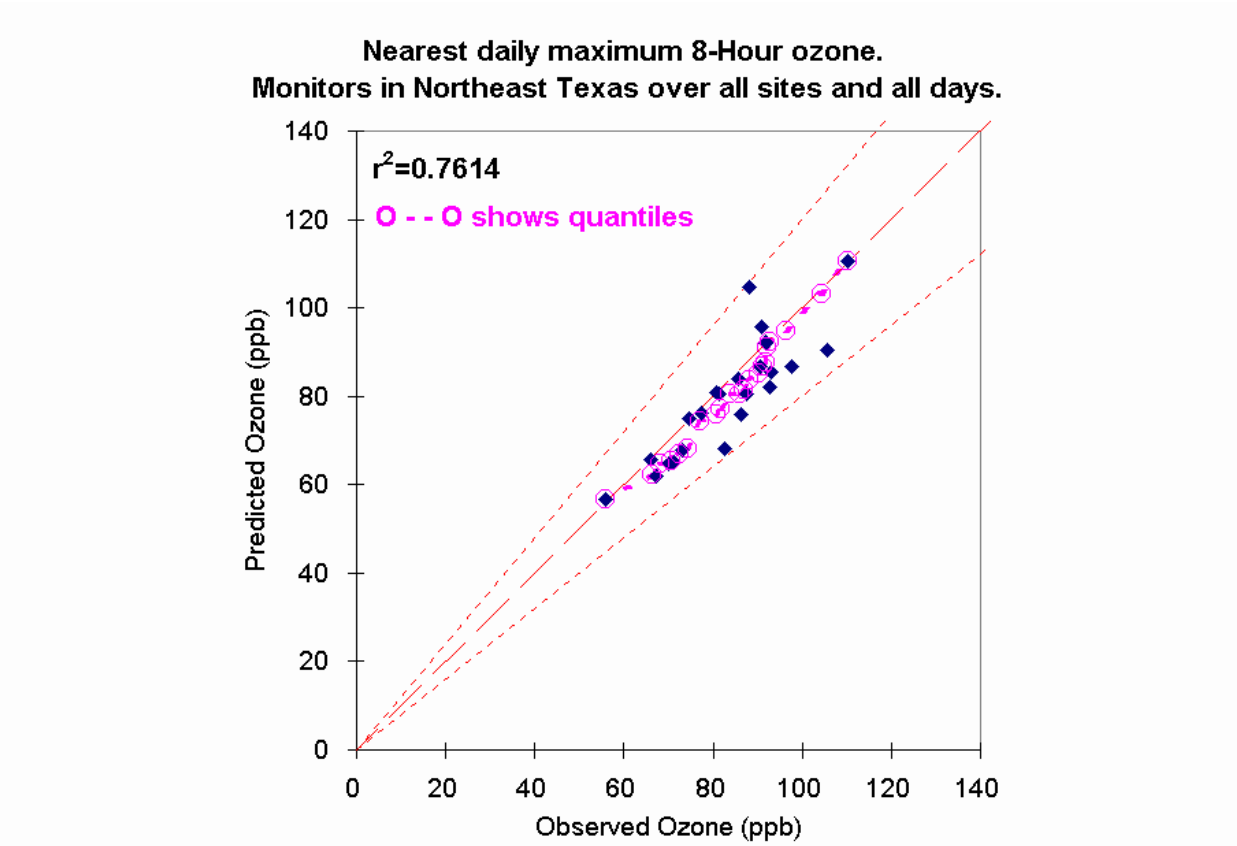


Figure 6-4. Scatter plot of nearest observed and predicted 8-hour ozone (ppb) near monitor locations in Northeast Texas. Quantiles are also shown as circles and the dashed lines show +/- 20% bias. The r^2 value is the correlation coefficient.

Conclusions on Model Performance

The model performance evaluation results presented and discussed above show that the perception of model performance depends upon the methodology used for evaluation. Therefore, it is important to look at the model performance evaluation as a whole and seek to determine whether the model is suitable for use in the intended purpose of an 8-hour ozone attainment demonstration. Overall conclusions from the performance evaluation are:

- Modeled ozone formation is consistent with conceptual model in showing that high ozone levels in Northeast Texas resulted from a combination of production from local emissions sources combined with a regional background and transport of ozone.
- There is some evidence for ozone under prediction near the beginning and end of the episodes and this appears to result from the model having too low ozone transport into Northeast Texas from the east and northeast.
- Model performance is acceptable on most days when evaluated using the more traditional methods developed for 1-hour ozone modeling (such as the normalized bias).
- Model performance is very good when evaluated using newer methods developed in EPA's draft modeling guidance (EPA, 1999) that compare ozone levels near monitor locations and better correspond to the 8-hour ozone attainment demonstration methodology.

The overall conclusion is that the ozone modeling is suitable for use in an 8-hour ozone attainment demonstration for Northeast Texas.

MODELING PROCEDURES FOR 2002 AND 2007

The purpose of the future year ozone modeling is to project whether Northeast Texas will be attaining the 8-hour ozone standard in 2007. This analysis is referred to as an "attainment demonstration" based on ozone modeling. The attainment demonstration depends upon changes in modeled ozone levels between a base and a future year and so it is important that the base and future year modeling be as consistent as possible. The objective is to ensure that modeled ozone changes between the base and future year result from emissions changes and therefore provide an accurate and realistic estimate of the ozone changes that will occur in Northeast Texas. As discussed in detail below, the attainment demonstration relied upon changes in modeled ozone levels between a base year of 2002 and a future year of 2007.

The only difference between the modeling for 1999, 2002 and 2007 was in the anthropogenic emissions inputs to the CAMx model as described in section 3. Specifically, between years there were:

- No changes to the CAMx model (version 4.02).
- No changes to the CAMx model options.
- No changes to the meteorological input files.
- No changes to the initial and boundary conditions.
- No changes to the biogenic emissions.

With these modeling methods and assumptions all changes in ozone levels between modeled years are due solely to the effects of emissions growth and controls. The emission inventory development was described above in section 3 and the emissions control measures assumed to be in place for 2007 are described next.

The final 2002 base case model run was called "02base3" and the final 2007 model run was called "07base5." Modeled ozone levels in the 4-km grid are shown for 2002 in Appendix C and for 2007 in Appendix D. The changes in modeled ozone levels from 1999 to 2002 to 2007 and their relationship to emissions changes were investigated using the ozone source apportionment technology (OSAT) option in CAMx, as described in section 7.

EMISSION CONTROLS FOR 2007

The 2007 emission inventories rely upon emission control measures that are currently enforceable. These measures are a combination of Federal measures developed by EPA, State measures developed by Texas for the State Implementation Plan (SIP) and local measures developed by NETAC that have been made enforceable by agreed orders.

On-road Mobile Sources

The following federal emission reduction programs for on-road vehicles were accounted for using EPA's MOBILE6 model:

- Tier 1 light-duty vehicle standards, beginning with the 1996 model year
- National Low Emission Vehicle (NLEV) standards for light-duty vehicles, beginning with model year 2001
- Tier 2 light-duty vehicle standards, beginning with model year 2005, with low sulfur gasoline beginning in the summer of 2004
- Heavy-duty vehicle standards, beginning with model year 2004
- Heavy-duty vehicle standards (with low sulfur diesel), beginning with model year 2007.

Off-road Mobile Sources

The following federal emission reduction programs for off-road vehicles were accounted for using EPA's NONROAD model:

- Phase 1 and 2 emission standards for new off-road spark-ignition engines at or below 25 horsepower (hp). Different starts and phase-in periods depending on engine size. Earliest start year is 1997 model year.
- Emission standards for new gasoline spark-ignition marine engines. Phase-in starts with 1998 model year.
- Tier 1 and Tier 2 emission standards for new off-road compression-ignition engines below 50 hp, including recreational marine engines less than 50 hp. Phase-in period differs by Tier and engine size. Earliest start year is 1997 model year.
- Tier 1 through Tier 3 emission standards for new off-road compression-ignition engines at or above 50 hp, not including recreational marine engines greater than 50 hp. Phase-in period differs by Tier and engine size. Earliest start year is 1996 model year.

Emissions from aircraft, commercial marine and locomotives are estimated outside of the NONROAD model. Commercial marine emissions in the NETAC area are negligible. No emission controls were assumed for aircraft. Locomotive emissions were adjusted to account for EPA regulations promulgated in 1997.

Stationary Sources

The impact of control programs on stationary sources was modeled separately for Northeast Texas, the rest of Texas and States outside Texas. For stationary (area and point) sources outside of Texas, the 2007 anthropogenic emission inventories were the modeling inventories developed by EPA for a rulemaking on "heavy duty diesel" emissions and include EPA's estimates of emission reductions including the NOx SIP Call.

For area and point sources within Texas, the 2007 emission inventory includes reductions due to all of the TCEQ's State Implementation Plans (SIPs) for the non-attainment areas (Houston-Galveston, Beaumont-Port Arthur, Dallas/Fort Worth) and other areas as published in the Texas Administrative Code (Coulter-Burke et al., 2002). In some cases this tends to under-state the emission reductions because some SIP strategies have yet to be published as rules in the Texas Administrative Code.

Major Point Sources in Northeast Texas

Emissions at several major point sources in Northeast Texas were reduced to reflect control measures implemented in the 1-hour ozone SIP for Northeast Texas adopted by the TCEQ on March 13, 2002. This SIP includes NOx emission reductions from utility sources operated by American Electric Power (AEP) and Texas Utilities (TXU), as well as NOx emission reductions at Eastman Chemical Company, Texas operations (Eastman). These local reductions were developed voluntarily through NETAC and made enforceable through agreed orders.

The NOx emissions for the utility sources affected by NETAC local controls were estimated by multiplying the permit limit emission factors (lb NOx/mmBtu) by heat input values (mmBtu/hour) from a July 1997 ozone episode period. This is the same methodology (and therefore the same emissions) as used in the 1-hour ozone SIP modeling for Northeast Texas (TNRCC, 2002). The resulting daily emission rates and the reductions due to controls in 2007 are shown in Tables 6-6 and 6-7. The dates when these controls were implemented differed by facility as shown in Table 6-8. Most of the reductions in NOx emissions at major point sources in Northeast Texas were implemented by 2002 and, with the exception of one unit, all were implemented by the 2003 ozone season.

Table 6-6. Reductions in AEP 2007 NOx emissions due to NETAC local controls.

Facility	2007 Base Case		2007 Strategy		Reduction	
	lb/mmBtu	ton/day	lb/mmBtu	ton/day	ton/day	Percent
Wilkes						
Unit 1	N/A	1.5	N/A	1.5	0.0	0%
Unit 2	0.31	5.3	0.17	2.9	2.4	45%
Unit 3	0.38	5.8	0.17	2.6	3.2	55%
All units		12.6		7.0	5.6	44%
Knox Lee						
Unit 2	N/A	0.3	N/A	0.3	0.0	0%
Unit 3	N/A	0.3	N/A	0.3	0.0	0%
Unit 4	N/A	2.1	N/A	2.1	0.0	0%
Unit 5	0.24	4.4	0.18	3.2	1.1	26%
All units		7.1		6.0	1.1	16%
Pirkey	0.31	25.4	0.22	17.9	7.5	29%

Note: N/A = information not available

Table 6-7. Reductions in TXU 2007 NOx emissions due to NETAC local controls.

TXU	2007 Base Case		2007 Strategy		Reduction	
	lb/mmBtu	ton/day	lb/mmBtu	ton/day	ton/day	Percent
Martin Lake						
Unit 1	0.34	31.4	0.2	18.5	12.9	41%
Unit 2	0.31	30.5	0.2	19.7	10.8	35%
Unit 3	0.38	36.2	0.2	19.2	17.0	47%
All units		98.1		57.3	40.7	42%
Monticello						
Unit 1	0.29	21.7	0.2	14.9	6.8	31%
Unit 2	0.30	21.6	0.2	14.6	7.0	32%
Unit 3	0.24	22.8	0.2	18.8	4.0	18%
All units		66.1		48.3	17.8	27%

Table 6-8. Implementation schedule for point source NOx reductions in Northeast Texas.

Facility	Implemented
American Electric Power (AEP)	
Pirkey	Fall 2001
Welsh (Unit 1)	Fall 1999
Welsh (Unit 2)	Spring 2005*
Welsh (Unit 3)	Fall 2000
Wilkes (Unit 2)	Fall 1999
Wilkes (Unit 3)	Spring 2000
Knox Lee (Unit 5)	Fall 2000
TXU	
Martin Lake (Unit 1)	Spring 2003
Martin Lake (Unit 2)	Spring 2001
Martin Lake (Unit 3)	Spring 2002
Monticello (Unit 1)	Spring 2002
Monticello (Unit 2)	Spring 2003
Monticello (Unit 3)	Fall 2000
Stryker Creek (Unit 1)	Spring 2003
Stryker Creek (Unit 2)	Spring 2000
Eastman Chemical Company	
Longview	2000 - 2002

*Scheduled

The NOx emission reduction strategies at Eastman comprise numerous measures including the replacement of two large boilers by a co-generation plant, improved compressor engines and other measures. The reductions in NOx emission at Eastman from 1999 to 2002 are shown in Table 6-9. The NOx totals for 2002 (and 2007) include 2.1 tons/day of emissions from the co-generation unit that is a separate facility but are included in Table 6-9 because Eastman agreed to offset the co-gen emissions as part of their overall NOx reduction commitment. The 2007 Eastman NOx emissions in Table 6-9 were projected from 2002 levels assuming 5% overall growth. Table 6-9 shows an apparent increase in VOC emissions from 1999 to 2002 but this does not reflect any real increase in emissions, but rather is a paper increase due to improved inventory methods for 2002 that result in higher VOC estimates. The 2007 Eastman VOC emissions were projected from 2002 levels assuming 10% growth.

Table 6-9. Emissions (tons/day) for Eastman Chemical Company, Texas operations in Longview.

	NOx	VOC
1999	14.4	10.7
2002	9.3	11.8
2007	9.7	12.9

Note: The NOx totals for 2002 and 2007 include 2.1 tons/day of emissions from a co-generation unit that is a separate facility but are included in this table because Eastman agreed to offset the co-gen emissions as part of their overall NOx reduction commitment.

ATTAINMENT DEMONSTRATION PROCEDURES

The methodology for the 8-hour ozone attainment demonstration follows the draft modeling guidance issued by EPA (EPA, 1999). The methodology calls for scaling base year design values (DVs) using relative reduction factors (RRFs) from a photochemical model in order to estimate future design values using the following equations:

Future Year DV = Base Year DV × RRF

RRF = Future Year Modeled Ozone / Base Year Modeled Ozone

This methodology is conceptually simple, but the implementation is complicated and is described in detail below. This methodology was implemented in a computer program to automate the calculation for efficiency and reliability.

Base Year: 2002

The base year for the attainment demonstration was 2002. This involved modeling ozone levels with a 2002 emissions inventory and using design values for the 3-year period centered on 2002, i.e., 2001-2003 Design Values. A base year of 2002 was selected because:

- EPA is using the 2001-2003 design values to determine the attainment status for Northeast Texas under the 8-hour ozone standard.
- There have been substantial emissions reductions in Northeast Texas since the August 15-22, 1999 ozone episode, and these have been accompanied by a decline in 8-hour ozone design values.
- Using the most recent emissions (2002) and air quality data (2001-2003) results in less extrapolation in projecting 2007 Design Values than if older emissions/air quality data are used.

The NETAC Technical Committee developed this methodology in early 2003 with approval from the EPA and TCEQ.

Calculating Relative Reduction Factors (RRFs)

RRFs are calculated for each monitor location. In addition, since high ozone can also occur away from monitor locations, a screening calculation is carried out to identify grid cells with consistently high ozone. If any screening cells are identified, RRFs are then calculated for the screened grid cells. The idea behind the screening cells is to account for any areas with consistently high modeled ozone that are not captured by the monitoring network. The attainment test is passed when all the future year scaled DVs are 84 ppb or lower. Scaled DVs are truncated to the nearest ppb.

Figure 6-5 shows a schematic outline of the calculations and identifies the input data required to complete the calculation. These are:

1. A monitor list – the list of monitors along with base year DVs for each monitor.
2. A screening cell list – the list of cells to be considered in the screening cell calculation along with the monitors that are considered to be associated with that grid cell. This list may be a sub-set of the modeling grid covering just the area for which controls are being developed. The significance of associating monitors with each grid cell is in the selection of an appropriate base year DV for the grid cell and in setting concentration thresholds for including the grid cell in the screening calculation, discussed below. There are no firm criteria for deciding how to associate monitors with grid cells.
3. Base case ozone – gridded 8-hour daily maximum ozone for the base year.
4. Future case ozone – gridded 8-hour daily maximum ozone for the future year.

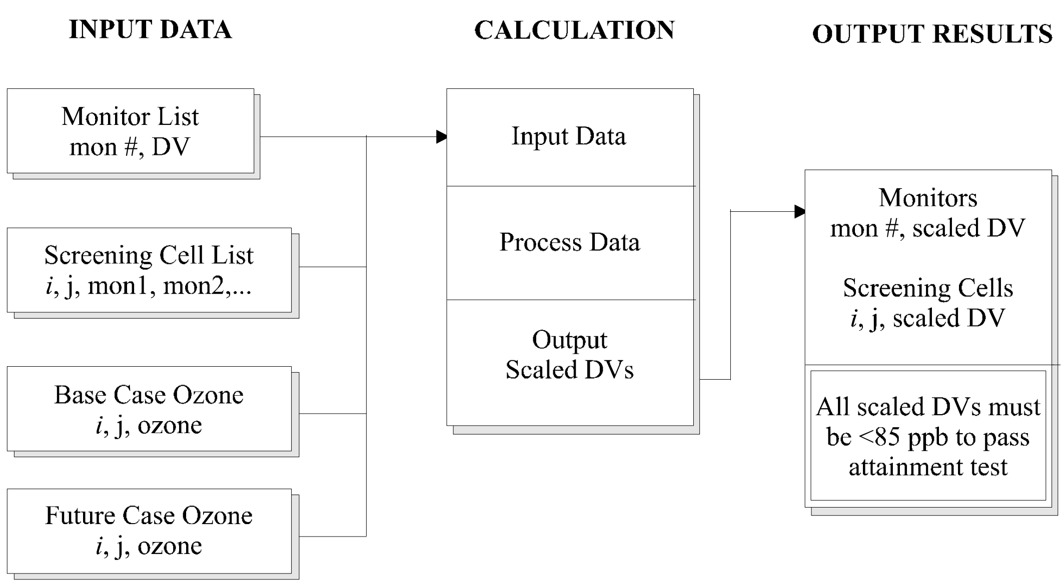


Figure 6-5. Overview of the 8-hour ozone attainment test methodology.

The details of the calculations are as follows:

- Monitor DV Scaling

1. For each monitor, find the daily maximum 8-hour ozone in an *n* x *n* block of cells around the monitor for both the base and future case. Repeat for each modeling day being used for control strategy development. For a 4 km grid, *n*=7 according to the guidance.
2. Exclude days when the base case daily maximum 8-hour ozone was below 70 ppb.
3. Average the daily maximum 8-hour ozone across days for the base and future year.
4. Calculate the RRF = (average future daily max) / (average base daily max).
5. Calculate the scaled DV = base year DV x RRF.
6. Repeat 1-5 for each monitor

- Screening Cell DV Scaling

7. For each grid cell on the screening cell list, count the number of days where the modeled daily maximum 8-hour ozone is at least 5% greater than the modeled daily maximum 8-hour ozone at any "associated" monitor, and at least 70 ppb.
8. If the number of days is 50% or greater of the total days, treat this cell as if it were a monitor – this is a "screened cell."
9. The base year DV to be used for a screened cell is the maximum of the base year DVs for any "associated" monitor.
10. Calculated the scaled DV for each screened cell as if it were a monitor (steps 1-5 above).
11. Repeat 7-10 for each grid cell on the screening cell list.

ATTAINMENT DEMONSTRATION

The EPA design value scaling methodology was applied for all ozone monitoring locations in Northeast Texas in 2003. The screening cell methodology described above identified no screening cells to be considered in addition to the monitor locations. The Longview and Tyler monitors have full 2001-2003 DVs whereas the Karnack and Waskom monitors have 2-year (2002-2003) DVs. The RRFs at all four monitor locations are less than 1.0 showing that modeled ozone levels across Northeast Texas decreased from 2002 to 2007.

Table 6-10. Projected 2007 8-hour ozone design values (DV; ppb) for Northeast Texas ozone monitor locations in 2003.

Monitor	Preliminary 2003 Design Value	Modeled Relative Reduction Factor	Projected 2007 Design Value
Longview	82	0.981	80
Tyler	81	0.954	77
Karnack	84	0.966	81
Waskom	84	0.974	82

Notes: 2003 DVs are based on preliminary 2003 monitoring data.
The Longview and Tyler monitors have 2001-2003 DVs.
The Karnack and Waskom monitors have 2002-2003 DVs.

The ozone modeling demonstrates attainment of the 8-hour ozone standard in 2007 because the projected 2007 DVs shown in Table 6-10 are all less than 84 ppb. As discussed above, the 2007 control strategy relies entirely upon measures that are already enforceable including substantial NOx reductions at local point sources developed by NETAC. NETAC is continuing to develop additional local reductions for Northeast Texas.

The conclusion based on modeling that Northeast Texas will continue to demonstrate attainment of the 8-hour ozone standard in 2007 is conservative in several ways:

- The projected 2007 8-hour ozone levels at Longview and Tyler are 4 and 7 ppb below the highest level that would demonstrate attainment (84 ppb) providing a margin of safety.
- Additional emissions reductions beyond those assumed in the modeling are expected to occur by 2007.
- The relative reduction factors used to project the 2007 design values depend upon ratios of 2007 to 2002 modeled ozone levels. The utility emission estimates for 2007 are more conservative than for 2002 (permit maximum rather than summer average levels, see section 3) which introduces a bias toward higher projected 2007 ozone levels.

WEIGHT-OF-EVIDENCE SUPPORTING THE ATTAINMENT DEMONSTRATION

This section considers whether the weight-of-evidence supports the conclusions from the ozone modeling that ozone levels in Northeast Texas will continue to decline and that consequently the area will move further into compliance with the 8-hour ozone standard by 2007. Given that the ozone control strategy for Northeast Texas focuses on NOx reductions, the weight-of-evidence analysis considers three factors:

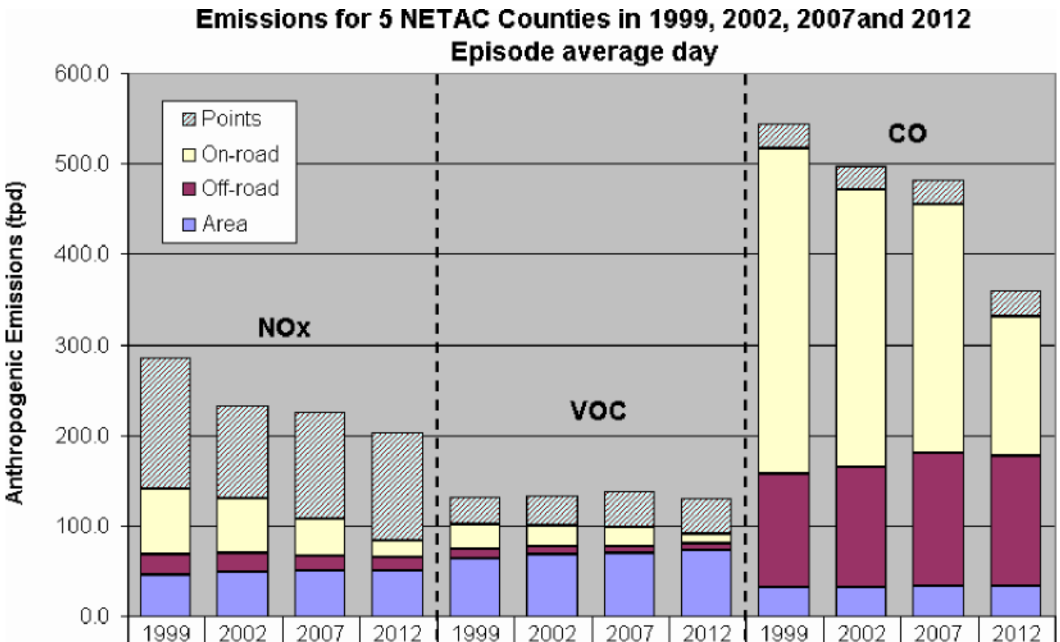
1. Evidence that ozone levels in Northeast Texas will respond to reductions in NOx emissions.
2. Trends in NOx emissions.
3. Ozone trends as NOx reductions have been implemented in recent years.

The conceptual model completed by Stoeckenius et al. (2004) considered whether ozone levels are expected to be more responsive to NOx or VOC reductions and concluded that ozone production in Northeast Texas is expected to be NOx limited. This conclusion was based on the high VOC:NOx ratio (greater than 30) in the emission inventory which is well within the NOx-limited regime. The high VOC:NOx ratio results from high biogenic emission levels which are generally considered to lead to NOx-limited ozone formation in forested, predominantly rural areas like Northeast Texas. Emissions sensitivity tests using the August 1999 ozone model (discussed above) also showed that NOx reductions were the most effective way of reducing ozone. Therefore, the weight-of-evidence suggests that ozone will respond to NOx reductions.

The trends in NOx emissions from 1999 to 2012 were by Stoeckenius et al., (2004) and are shown in Figure 6-6. This analysis showed that total anthropogenic NOx emissions decrease consistently from 1999 to 2012 due primarily to decreases in point source NOx in the early years and decreases in mobile source NOx in the later years. The decreases in NOx emissions from 1999 levels were:

- 18 percent NOx reduction from 1999 levels by 2002
- 21 percent NOx reduction from 1999 levels by 2007
- 29 percent NOx reduction from 1999 levels by 2012

Therefore, the weight-of-evidence is that NOx emission levels have reduced significantly since 1999 will become still lower in the next few years and out to at least 2012.



	NOx 1999	NOx 2002	NOx 2007	NOx 2012	VOC 1999	VOC 2002	VOC 2007	VOC 2012	CO 1999	CO 2002	CO 2007	CO 2012
Points	144.7	102.1	118.5	118.5	29.9	33.0	39.5	39.5	27.4	25.8	28.3	28.3
On-road	72.9	61.6	40.0	19.2	27.7	23.2	21.3	11.0	359.1	307.5	274.2	154.2
Off-road	21.9	19.9	16.8	13.9	9.8	9.3	7.7	7.8	126.1	132.5	147.1	142.8
Area	46.0	49.0	50.1	50.6	63.7	67.4	69.5	72.1	31.1	32.0	33.0	34.0

Figure 6-6. Trends in Northeast Texas episode average anthropogenic emissions (tons/day) from 1999 to 2012.

The trends in annual fourth highest daily maximum 8-hour values for monitors in Northeast Texas were shown in Section 1 (Figure 1-4). All sites show decreases from 1999 to 2003 as NOx reductions were implemented. The monitors in nearby Shreveport also showed decreases over the same time period suggesting that the trend may be, in part, a regional phenomenon. However, the downward trend at the Longview monitor has been steeper than at any other monitor and the ozone levels at Longview are now comparable to Tyler whereas they were consistently higher in the late 1990s and 2000. The ozone trends suggest that emission reductions in Northeast Texas starting in about 2001 have been effective in reducing ozone levels, especially at Longview.

The three factors considered in the weight-of-evidence analysis all support the attainment demonstration based on ozone modeling and suggest that ozone levels will continue to improve over the next few years. The improvement may not be consistent in every year due to variations in weather that affect high ozone levels. Annual variability in ozone levels is the reason why attainment of the ozone standard is determined from 3 years of monitoring data.

7. SOURCE CONTRIBUTIONS TO OZONE

One of the unique features of CAMx is the availability of several "probing tools" to provide additional diagnostic and sensitivity information for an ozone simulation. The probing tools can be used to answer questions such as:

- Which emissions cause high ozone?
- How will ozone levels respond to emission changes?
- How important are the initial and boundary conditions?
- What are the influences of different model processes (chemistry, deposition, etc.) on ozone levels at a specific location?

The probing tools can also provide information for ozone precursors. The tools that are available have differing capabilities and uses. This section briefly describes the available probing tools and then presents results from the application of ozone source apportionment to the 1999, 2002 and 2007 base case simulations for Northeast Texas.

SUMMARY OF CAMx PROBING TOOLS

The probing tools available in version 4.0 of CAMx are:

- Ozone Source Apportionment Technology (OSAT) and related methods (APCA).
- The Decoupled Direct Method (DDM) for sensitivity analysis.
- Process Analysis.

OSAT provides information about the relationships between ozone concentrations and sources of precursors in the form of ozone source apportionments. Source apportionment means that the sum of the source contributions adds up to exactly 100% of the total ozone and so all of the ozone is accounted for. OSAT attributes ozone among all of the potential sources of ozone in the simulation, namely emissions, boundary conditions and initial conditions. Ozone formation from VOC and NOx precursors is tracked separately. The emissions contributions can be broken down by geographic area and/or source category. The OSAT methods are described in the CAMx User's Guide (ENVIRON, 2004) and in Dunker et al., (2002b).

Because ozone formation chemistry is a non-linear process, there is no unique way of apportioning ozone back to precursor sources. The OSAT methods attribute ozone formation to precursors that were present at the time the ozone was formed. There are two schemes for doing this called OSAT and APCA. The OSAT or APCA results are just like any other ozone source apportionment in that they are not exact. However, OSAT and APCA are very helpful for estimating the relative importance of different sources and guiding control strategy development.

The difference between the OSAT and APCA schemes can be summarized as follows. OSAT apportions ozone formation based solely on what precursors were present when the ozone is formed. OSAT determines whether ozone formation is NOx or VOC limited in each grid cell at each time step, and attributes ozone production according to the relative contributions of the limiting precursor (VOC or NOx) from different sources present at that time. APCA modifies the OSAT method to account for the fact that biogenic emissions are not considered to be controllable, and therefore attributes ozone to controllable (anthropogenic) emissions whenever possible. The differences between OSAT and APCA are discussed in more detail below.

The DDM provides similar types of information to OSAT, but in terms of sensitivity coefficients rather than source apportionments. Sensitivity coefficients describe how ozone will change if a precursor source is changed and thus are useful for predicting the effects of control strategies. CAMx can calculate "first-order" sensitivity coefficients, which are the likely to be the most important sensitivities, and are somewhat similar to source apportionments. There are two major differences between DDM sensitivities and OSAT source apportionments: (1) Sensitivity coefficients can be negative, meaning that reducing emissions will increase ozone, whereas as source apportionments are never negative. An example would be an area with high NOx emissions where reducing NOx emissions will increase ozone and DDM will obtain negative ozone sensitivities to local NOx whereas OSAT will have zero or small ozone apportionments to local NOx. (2) Adding up all the first-order sensitivities over all sources of ozone and precursors usually explains only about 60% of the total ozone. The modeled ozone that is "unexplained" by the first-order sensitivity coefficients can be explained by higher-order sensitivities, but they are more difficult to calculate and difficult to interpret. An advantage of DDM sensitivity coefficients is that they are rigorously defined (mathematically) and so are unique. The value of this uniqueness is weakened if the sensitivities are interpreted as source apportionments because of the significant portion of the ozone that is "unexplained" by the first-order sensitivities. Further information on DDM is provided in Dunker et al. (2002 a and b) and the CAMx User's Guide (ENVIRON, 2004).

Process analysis (PA) is a method for obtaining more information on how CAMx predicted concentrations at a specific place and time. The CAMx concentrations are determined by numerous model processes (such as emissions, transport, chemistry, deposition) but the separate contribution of each process is hidden within the final concentration output. Process analysis allows the contribution of each process to be output and used in diagnostic analyses. This is useful for explaining "how the model got the answer it got" and thus understanding model performance issues. Process analysis is not well suited for understanding source contributions to ozone or predicting responses to emissions changes. Further information on process analysis is provided in the CAMx User's Guide (ENVIRON, 2004) and references therein.

Anthropogenic Precursor Culpability Assessment (APCA)

Applications of OSAT to the Eastern US consistently identify biogenic emissions as a major contributor to ozone formation. This is not surprising as biogenic VOC emissions are very reactive and dominate regional VOC emissions in the Eastern US, but this finding is not "policy relevant" for designing anthropogenic emissions ozone control plans. The APCA methodology was developed from OSAT to address this issue. APCA stands for Anthropogenic Precursor Culpability Assessment, and differs from OSAT in recognizing that certain emission groups are not controllable (i.e., biogenic emissions) and that apportioning ozone production to these emissions does not provide control strategy relevant information. To address this, in situations where OSAT attributes ozone formation to a non-controllable source category when it was due to the interaction of ozone precursors from a non-controllable (i.e., biogenic) and controllable emissions source, APCA re-directs the ozone attribution to the controllable precursor. In practice, biogenic emissions are the uncontrollable source category and APCA only attributes ozone production to biogenic emissions when ozone formation is due to the interaction of biogenic VOC with biogenic NOx. When ozone formation is due to biogenic VOC interacting with anthropogenic NOx under VOC-limited conditions (where OSAT would attribute ozone production to biogenic VOC's), APCA directs the attribution to the anthropogenic NOx precursors present. The result of using APCA instead of OSAT is that more ozone formation is attributed to anthropogenic NOx sources and little ozone formation is attributed to biogenic sources. APCA is not called a "source apportionment" technique because it expresses biases as to which sources should be implicated (i.e., those that are controllable), hence it is referred to as a "culpability assessment."

STRENGTHS AND LIMITATIONS OF OSAT AND APCA

The main advantage of OSAT and APCA is providing a clear apportionment of ozone concentrations among all of the sources of ozone precursors in CAMx. These precursor sources (emissions, boundary conditions and initial conditions) can be sub-divided into categories to provide refined analyses. For example the emissions can be sub-divided based on emissions category and/or geographic area. This information provides a clear understanding of which sources are involved in forming the ozone present at a specific place and time. The apportionments are based on the participation of precursor emissions in the ozone formation process.

The main limitation of OSAT and APCA is that, because ozone formation is not a linear process, the source contributions cannot be used to exactly calculate what emission reductions are needed to achieve a specific target ozone level. As ozone precursor emissions are reduced, the efficiency of ozone formation changes and controls may become more or less effective than expected. Thus, OSAT and APCA should be used as a guide for designing control strategies, but can not provide an exact control strategy solution.

SOURCE APPORTIONMENT ANALYSIS DESIGN

The OSAT and APCA probing tools were used for the source apportionment analyses. The APCA results are expected to be more useful because of the high contribution biogenic emissions in Northeast Texas. Emissions were divided into 4 source categories and 10 geographic areas as defined in Tables 7-1 and 7-2, respectively. The source areas are also shown as maps for the 36-km, 12-km and 4-km CAMx grids in Figure 7-1. This means that ozone was attributed back to VOC and NOx emissions from 40 source groups, in addition to the initial and boundary conditions. Source contribution were analyzed for the grid cells containing the Longview, Tyler and Cypress River monitors, and over all grid cells in the NETAC 5 county area combined.

Table 7-1. Emissions source category definitions for the OSAT and APCA analysis.

Source Category	Category Definition
BIO	Biogenic emissions
MV	Motor vehicle emissions
PT	Point source emissions (elevated and low level)
OAN	Other anthropogenic emissions (i.e., area plus off-road mobile)

Table 7-2. Emissions source area definitions for the OSAT and APCA analysis.

Area Number	Area Abbreviation	Area Definition
1	NETAC	NETAC area (Harrison, Gregg, Rusk, Smith, Upshur)
2	NET11	11 Counties surrounding NETAC (Camp, Cherokee, Franklin, Henderson, Marion, Morris, Nacodosches, Shelby, Titus, Wood, Van Zandt)
3	SHRV	Shreveport area (Caddo, Bossier, De Soto, Webster)
4	LA	Louisiana (excluding Shreveport)
5	AR	Arkansas
6	OK	Oklahoma
7	DFW	Dallas/Fort-Worth (8 Counties)
8	HGBPA	Houston/Galveston/Beaumont/Port-Arthur (11 Counties)
9	TX	Texas (excluding areas 1, 2, 7 and 8)
10	OTH	Other areas

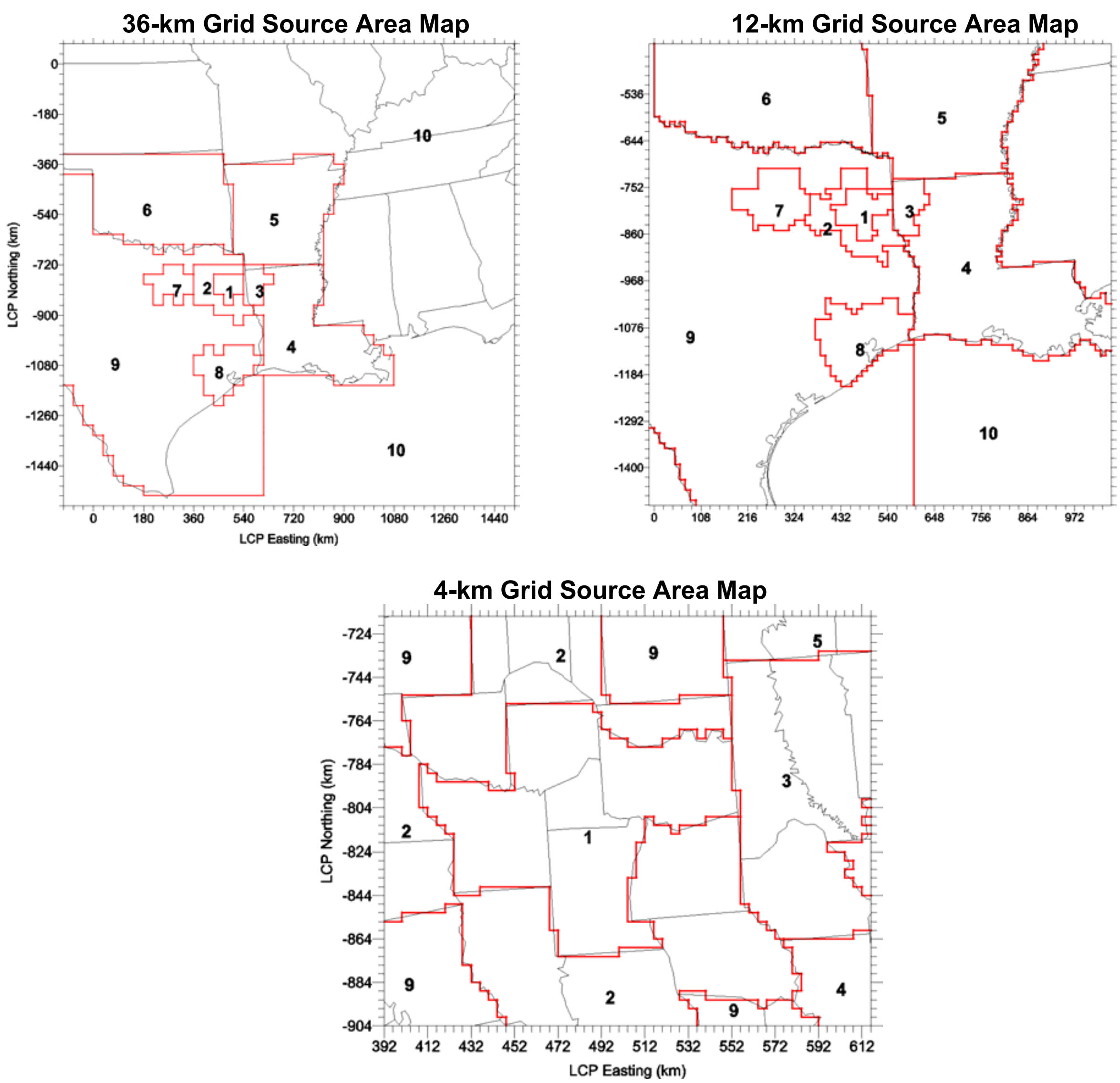


Figure 7-1. Maps showing the emissions source areas for the APCA analysis.

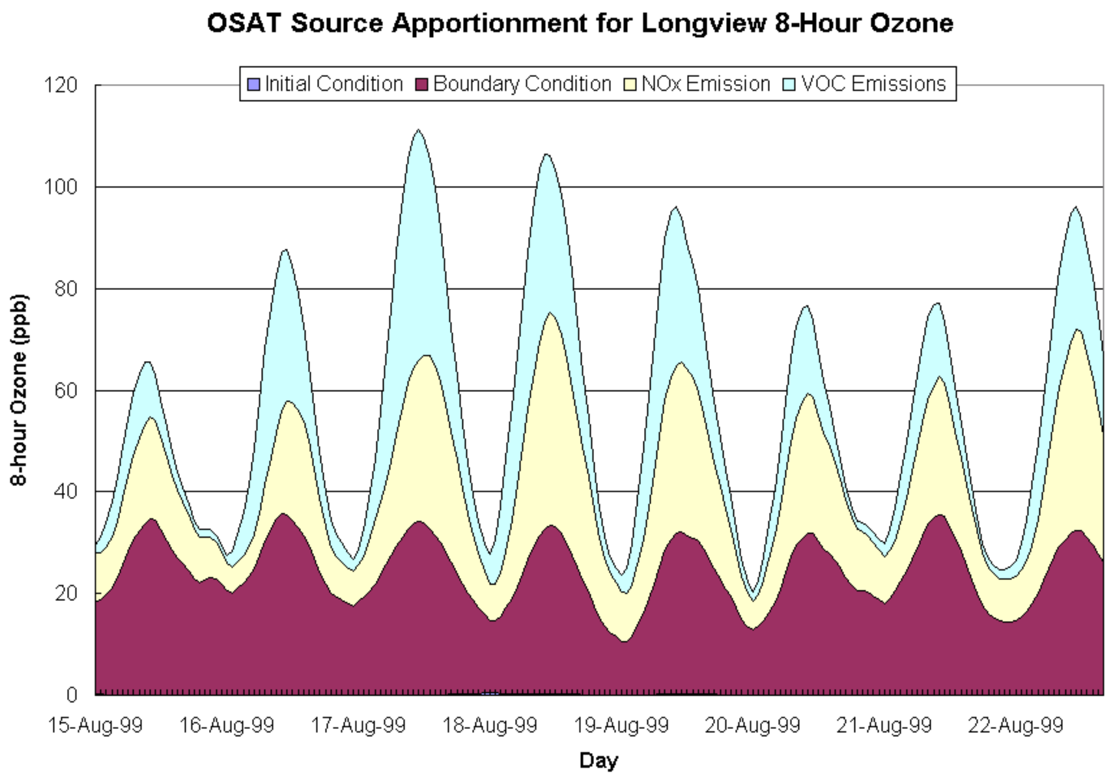
The 1999 base case (base7) was analyzed using both the OSAT and APCA algorithms in order to compare the resulting ozone source apportionments. The 1999 OSAT and APCA simulations used exactly the same model inputs and the only difference was the source apportionment algorithm in CAMx. As discussed above, APCA is designed to minimize attribution of ozone to biogenic emissions because they are not controllable.

COMPARING OSAT AND APCA

Figure 7-2 (top) shows the OSAT source apportionment for 8-hour ozone at Longview to initial conditions, boundary conditions, VOC emissions and NOx emissions. The contribution of initial conditions is negligible because the spin-up days have removed the influence of the initial conditions by August 15th. The contribution of the boundary conditions ranges from about 10 ppb to 30 ppb throughout the episode. An ozone boundary condition of 40 ppb was used for the 1999 base7 scenario, and the contribution of the boundary conditions at Longview is lower than 40 ppb because some ozone is lost to chemical reactions and deposition between the boundaries and Longview. Emissions are the main contributor to ozone at Longview, especially at times of high 8-hour ozone. NOx emissions contribute substantially more to ozone than VOC emissions on moderately high ozone days (August 15th, 20th, 21st), but the relative contributions of NOx and VOC emissions are comparable on the remaining very high ozone days. This shift from NOx limited ozone formation on moderately high ozone days toward more balanced contributions from NOx and VOC on very high ozone days is a response to the stagnant meteorology on the high ozone days. The stagnation leads to less dispersion of NOx emissions, which in turn leads to more VOC sensitive ozone formation. However, comparing the OSAT and APCA results shows that the VOCs involved in forming ozone under VOC limited conditions are predominantly from biogenic sources.

Figure 7-2 (bottom) shows the APCA source apportionment for 8-hour ozone at Longview to initial conditions, boundary conditions, VOC emissions and NOx emissions. The contributions of initial and boundary conditions are essentially the same as in the OSAT analysis. APCA attributes almost all of the remaining ozone formation to NOx emissions. This shows that the ozone attributed to VOCs by OSAT was in fact due to biogenic VOCs. Since biogenic VOCs are not controllable, APCA redirects this ozone attribution to biogenic VOCs to the NOx emissions that were present. The small amount of ozone attributed to VOC emissions by APCA was formed under VOC limited conditions and was either (1) formed by anthropogenic VOCs, or (2) formed by biogenic VOCs and biogenic NOx. Figure 7-3 will show that the second explanation applies in this case.

Figure 7-3 compares the OSAT and APCA apportionments for 8-hour ozone at Longview to the four emissions categories (biogenic, motor vehicle, area/off-road and point source) plus boundary and initial conditions. The initial and boundary conditions were discussed above. Biogenic emissions are identified by OSAT as a major contributor to ozone formation reflecting the high contribution of biogenic emissions to VOC emissions. APCA reduces the apportionment of ozone to biogenic emissions to almost zero and increases the apportionments to anthropogenic emissions to compensate. The small APCA contribution for biogenic emissions is from biogenic VOCs interacting with biogenic NOx, and is limited by the small contribution of biogenics to total NOx. The relative contributions of the anthropogenic emission categories will be discussed in more detail below. The remaining discussion uses just the APCA results.



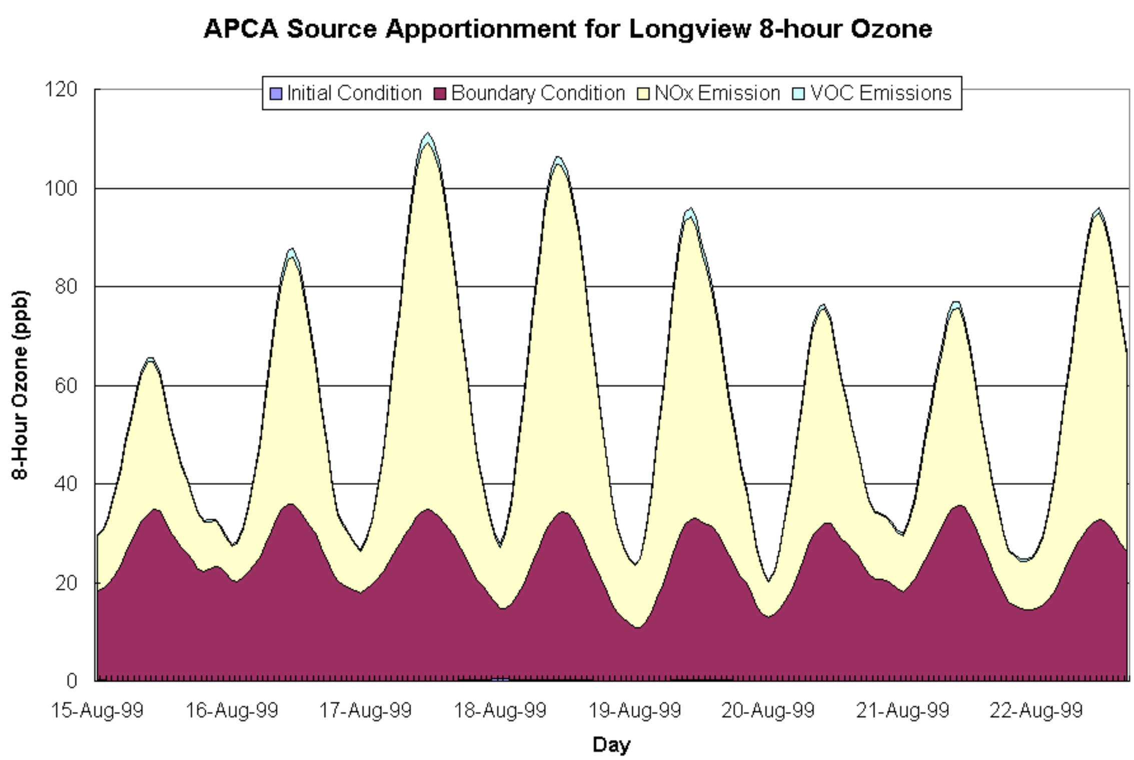
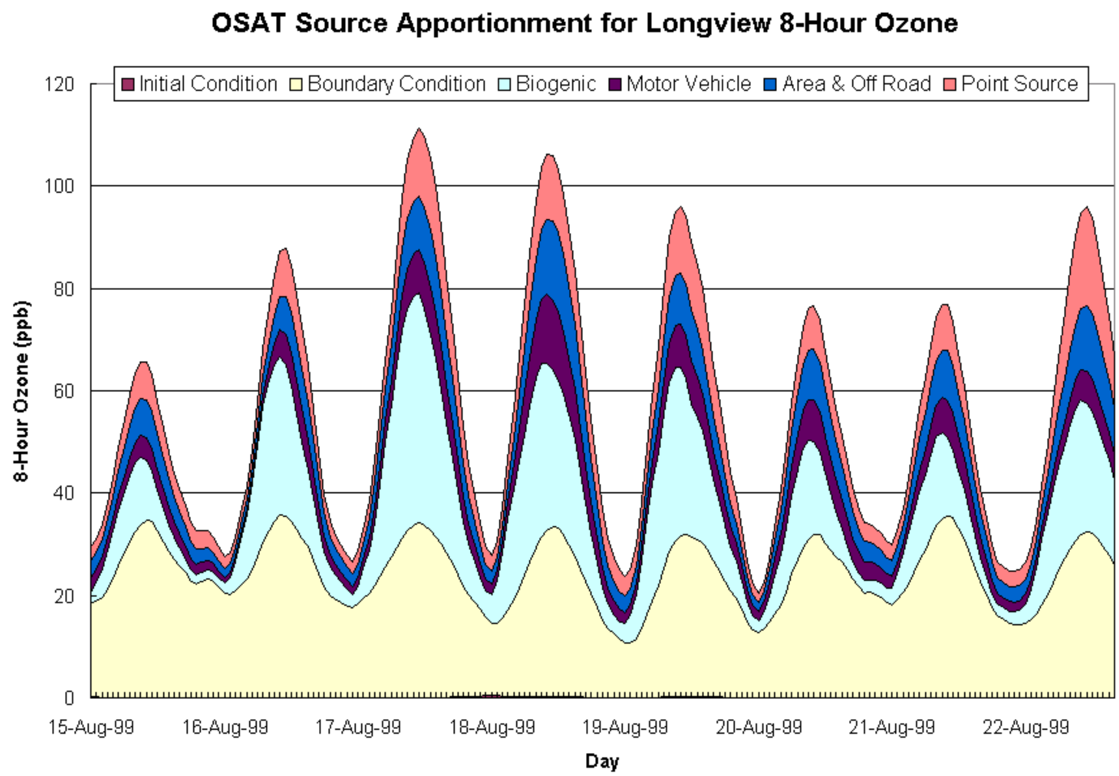


Figure 7-2. Source apportionment of Longview 8-hour ozone to VOC and NOx emissions using OSAT (top) and APCA (bottom).



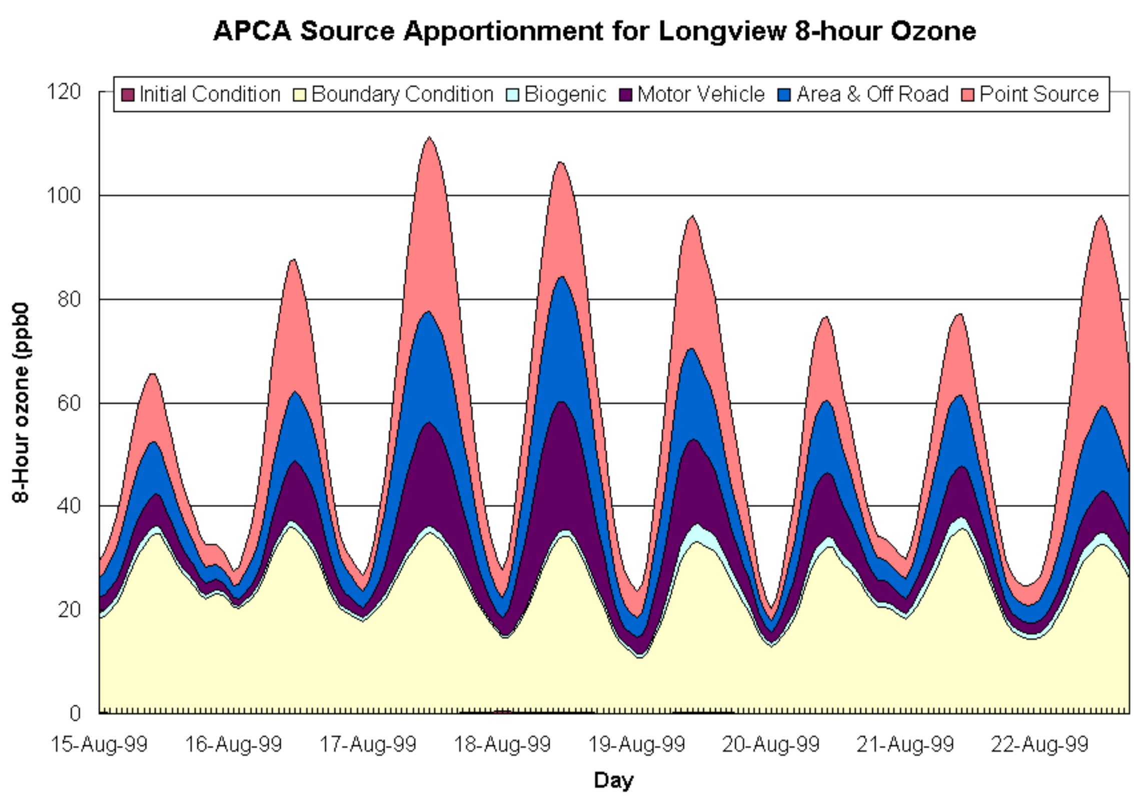


Figure 7-3. Source apportionment of Longview 8-hour ozone to source categories using OSAT (top) and APCA (bottom).

APCA OZONE CONTRIBUTIONS FOR 1999

The source apportionment analysis focused on identifying the contribution of anthropogenic emissions to ozone levels exceeding the level of the 8-hour ozone standard. Consequently, the analysis was restricted to hours when 8-hour ozone was 85 ppb or higher in the 1999 base case. The analysis was conducted for the grid cells containing the Longview, Cypress River and Tyler monitors, and for all grid cells in the 5-county NETAC area (i.e., area 1 in Figure 7-1). The APCA source contributions were averaged over all grid cells and hours matching this criterion. The contributions for the whole 5 county NETAC area are probably most representative because they include a larger number of grid cells and hours (Table 7-3), however the individual receptors were also included to reveal any differences between Longview, Tyler and Cypress River. Tables 7-4 to 7-8 summarize the emission totals (tons/day) by source area and are discussed in more detail below. The contributions of emissions to high 8-hour ozone are summarized in Tables 7-9 to 7-11 (these contributions are dominated by NOx rather than VOC, as discussed above).

Table 7-3. Number of grid cells and hours for each receptor with modeled 8-hour ozone of 85 ppb or higher in 1999.

Receptor	Number of grid cell hours
5 NETAC Counties	7713
Longview (CAMS 19)	29
Tyler (CAMS 82)	3
Cypress River (CAMS 50)	8

The total ozone amounts shown in Tables 7-9 and 7-11 should not be confused with ozone design values. The total ozone in these tables is just the average over those grid cells and hours when ozone was greater than 85 ppb in the 1999 modeling. Whether or not this value exceeds 85 ppb for 2002 or 2007 does not indicate whether the receptor is projected to attain the 8-hour ozone standard. The projected 2007 design values were discussed in section 6. The results shown in Table 7-9 to 7-11 do indicate which sources contribute to high 8-hour ozone levels in the modeling, and are helpful for designing 8-hour ozone control strategies.

Table 7-9 shows the average contributions to high 8-hour ozone in 1999 broken out to 40 emissions groups (ten areas by 4 categories) plus the initial and boundary conditions. The average contribution of initial conditions was 0.2 ppb or less and the average contribution of boundary conditions was 32 to 33 ppb, depending upon the receptor. This shows that the contribution of initial conditions is unimportant, and the contribution of boundary conditions is not dominant and is consistent with the boundary condition assumptions. The majority of the high 8-hour ozone (more than 66 percent) was attributed to anthropogenic emissions.

The largest emissions contributors to high 8-hour ozone in the NETAC 5 county area (Table 7-9, top left) was from nearby NOx sources. Nearby means emissions from within the 5 county NETAC area, followed by emissions in the surrounding 11 counties, followed by Louisiana emissions. NOx emissions within the 5 county area contributed 32% of the high 8-hour ozone and NOx emissions in the surrounding 11 county area contributed another 12%. The contribution from Louisiana NOx emissions was 7%, which was split about evenly between the Shreveport 4 parish area (3%) and the rest of the Louisiana (4%). NOx emissions from the rest of Texas (including DFW and HGBPA) contributed 8% and NOx emissions in all other states (including Arkansas and Oklahoma) also contributed 6% of high 8-hour ozone in the 5 county area.

At Longview and Tyler, emissions from NOx sources within the NETAC 5 county area were the largest emissions contributor to high 8-hour ozone, similar to the result for the 5 county area. However, at Cypress River the largest contributor was emissions from the 11 county area surrounding NETAC. This difference for Cypress River is due to the proximity of the Cypress River monitor to utility point source sources in Titus County (Monticello and Welsh) and Marion County (Wilkes) combined with the wind conditions during periods with 8-hour ozone above 85 ppb.

The contribution of NOx emissions was broken out between 3 sources of anthropogenic emissions: point sources, on-road mobile sources and other sources (i.e., area plus off-road). For the NETAC 5 county area (Table 7-9, top left) the ranking of these source categories was point sources (28%) followed by other anthropogenic (19%) followed by on-road mobile sources (16%). However, this ranking varies between monitor locations within the 5 county area. The Longview and Cypress River monitor locations are similar to the 5 county area as a whole, but point sources are less important at Tyler where the ranking changes to other anthropogenic (21%) followed by point sources (21%) followed by on-road mobile sources (18%).

Table 7-4. Emission totals for August 17th summarized for the source categories and source areas used in the OSAT and APCA analyses.

Source Area	NOx				VOC			
	BIO	MV	PT	OAN	BIO	MV	PT	OAN
NETAC	2	80	149	70	1121	26	25	50
NET11	5	40	188	68	2224	25	12	50
SHRV	4	38	68	76	1075	25	15	36
LA	103	349	1149	949	7253	203	175	441
AR	133	284	349	332	12314	173	68	383
OK	223	392	670	396	6857	366	68	298
DFW	52	345	151	229	622	180	29	213
HGBPA	20	271	703	249	1544	158	214	213
TX	878	671	1221	912	14440	417	131	860
OTH	1979	3691	7499	3282	64288	2280	1182	4202
Total	3399	6161	12146	6562	111738	3853	1918	6746

Table 7-5. 2002 Emission totals for August 17th summarized for the source categories and source areas used in the OSAT and APCA analyses.

Source Area	**NOx**				**VOC**			
	BIO	**MV**	**PT**	**OAN**	**BIO**	**MV**	**PT**	**OAN**
NETAC	2	67	102	71	1121	22	27	52
NET11	5	37	133	65	2224	22	11	52
SHRV	4	38	56	73	1075	24	15	37
LA	103	328	931	953	7253	192	172	441
AR	133	268	350	283	12314	161	68	398
OK	223	362	530	382	6857	246	68	303
DFW	52	311	102	225	622	150	25	219
HGBPA	20	245	538	246	1544	130	193	216
TX	878	628	826	888	14440	359	119	886
OTH	1979	3485	5972	2880	64288	2106	1182	4293
Total	3399	5769	9540	6066	111738	3413	1881	6896

Table 7-6. 2007 Emission totals for August 17th summarized for the source categories and source areas used in the OSAT and APCA analyses.

Source Area	NOx				VOC			
	BIO	MV	PT	OAN	BIO	MV	PT	OAN
NETAC	2	38	116	69	1121	13	32	52
NET11	5	27	142	56	2224	14	12	53
SHRV	4	27	53	82	1075	17	7	32
LA	103	237	1082	894	7253	134	164	357
AR	133	195	274	321	12314	113	28	353
OK	223	265	648	264	6857	173	52	296
DFW	52	208	89	196	622	101	33	208
HGBPA	20	160	663	273	1544	85	247	197
TX	878	445	1082	878	14440	247	175	921
OTH	1979	2549	3866	3214	64288	1489	924	3631
Total	3399	4152	8016	6248	111738	2384	1675	6101

Table 7-7. Ratio of 2002/1999 Emission totals for August 17th summarized for the source categories and source areas used in the OSAT and APCA analyses.

Source Area	NOx				VOC			
	BIO	MV	PT	OAN	BIO	MV	PT	OAN
NETAC	1.00	0.84	0.68	1.01	1.00	0.84	1.09	1.03
NET11	1.00	0.94	0.71	0.96	1.00	0.86	0.93	1.03
SHRV	1.00	1.00	0.83	0.97	1.00	0.99	1.01	1.01
LA	1.00	0.94	0.81	1.00	1.00	0.95	0.99	1.00
AR	1.00	0.94	1.00	0.85	1.00	0.93	1.00	1.04
OK	1.00	0.92	0.79	0.96	1.00	0.67	1.00	1.02
DFW	1.00	0.90	0.67	0.98	1.00	0.83	0.87	1.03
HGBPA	1.00	0.90	0.77	0.99	1.00	0.82	0.90	1.01
TX	1.00	0.94	0.68	0.97	1.00	0.86	0.91	1.03
OTH	1.00	0.94	0.80	0.88	1.00	0.92	1.00	1.02
Total	1.00	0.94	0.79	0.92	1.00	0.89	0.98	1.02

Note: The source areas are defined in Table 7-2 and the emission categories are defined in Table 7-1

Table 7-8. Ratio of 2007/1999 Emission totals for August 17th summarized for the source categories and source areas used in the OSAT and APCA analyses.

Source Area	NOx				VOC			
	BIO	MV	PT	OAN	BIO	MV	PT	OAN
NETAC	1.00	0.48	0.78	0.98	1.00	0.49	1.31	1.04
NET11	1.00	0.67	0.76	0.82	1.00	0.54	1.07	1.05
SHRV	1.00	0.71	0.78	1.09	1.00	0.68	0.44	0.88
LA	1.00	0.68	0.94	0.94	1.00	0.66	0.94	0.81
AR	1.00	0.69	0.79	0.97	1.00	0.65	0.42	0.92
OK	1.00	0.68	0.97	0.67	1.00	0.47	0.77	1.00
DFW	1.00	0.60	0.59	0.86	1.00	0.56	1.14	0.98
HGBPA	1.00	0.59	0.94	1.10	1.00	0.54	1.16	0.93
TX	1.00	0.66	0.89	0.96	1.00	0.59	1.34	1.07
OTH	1.00	0.69	0.52	0.98	1.00	0.65	0.78	0.86
Total	1.00	0.67	0.66	0.95	1.00	0.62	0.87	0.90

Note: The source areas are defined in Table 7-2 and the emission categories are defined in Table 7-1

Table 7-9. Average ppb contributions to high 8-hour ozone for 1999 (base7).

5 NETAC Counties

Source Area	Source Category						
	PT	MV	OAN	BIO	BC	IC	Total
NETAC	11.3	9.2	8.6	0.2			29.4
NET11	7.8	0.9	2.7	0.1			11.5
SHRV	1.0	0.5	1.1	0.1			2.6
LA	1.3	0.7	1.4	0.2			3.7
AR	0.6	0.4	0.6	0.2			1.8
OK	0.5	0.4	0.4	0.1			1.3
DFW	0.2	0.6	0.5	0.1			1.5
HGBPA	0.3	0.2	0.2	0.0			0.6
TX	1.1	0.8	1.1	0.5			3.4
OTH	2.1	1.0	1.0	0.5			4.6
N/A					32.5	0.2	32.7
Total	26.1	14.7	17.4	2.0	32.5	0.2	92.9

Longview

Source Area	Source Category						
	PT	MV	OAN	BIO	BC	IC	Total
NETAC	15.9	12.3	11.2	0.2			39.5
NET11	4.1	0.6	2.2	0.1			7.0
SHRV	1.2	0.5	1.0	0.1			2.8
LA	1.4	0.8	1.5	0.2			3.9
AR	0.6	0.4	0.6	0.2			1.7
OK	0.3	0.2	0.3	0.1			0.8
DFW	0.2	0.5	0.4	0.1			1.1
HGBPA	0.2	0.1	0.1	0.0			0.5
TX	0.8	0.6	0.8	0.4			2.5
OTH	2.3	1.0	1.0	0.5			4.8
N/A					32.3	0.1	32.4
Total	26.9	16.9	19.1	1.8	32.3	0.1	97.0

Tyler

Source Area	Source Category						
	PT	MV	OAN	BIO	BC	IC	Total
NETAC	8.1	10.5	9.0	0.3			27.9
NET11	1.4	0.4	2.4	0.1			4.3
SHRV	1.5	0.5	1.1	0.1			3.2
LA	2.0	0.9	2.1	0.5			5.5
AR	1.4	1.0	1.4	0.4			4.2
OK	0.2	0.2	0.2	0.0			0.6
DFW	0.0	0.0	0.0	0.0			0.1
HGBPA	0.3	0.1	0.1	0.0			0.5
TX	0.2	0.3	0.6	0.1			1.3
OTH	2.6	1.2	1.4	0.8			6.0
N/A					32.4	0.0	32.4
Total	17.7	15.1	18.4	2.3	32.4	0.0	85.8

Cypress River

Source Area	Source Category						
	PT	MV	OAN	BIO	BC	IC	Total
NETAC	4.6	2.9	3.4	0.1			11.1
NET11	21.8	1.9	7.1	0.2			31.0
SHRV	1.0	0.7	1.4	0.1			3.2
LA	1.1	0.7	1.4	0.2			3.4
AR	1.1	0.6	1.0	0.3			3.0
OK	0.1	0.1	0.1	0.0			0.2
DFW	0.0	0.0	0.0	0.0			0.0
HGBPA	0.1	0.0	0.0	0.0			0.1
TX	1.2	1.7	2.7	0.3			5.9
OTH	1.9	0.8	0.8	0.4			3.8
N/A					33.3	0.1	33.4
Total	32.8	9.4	17.8	1.6	33.3	0.1	95.0

OZONE CONTRIBUTIONS FOR 2002 AND 2007

The analysis of the 2002 and 2007 base case results (Tables 7-10 and 7-11) was designed to be consistent with the 1999 analysis so that source contributions can be compared directly between years. In order to obtain a direct comparison, the ozone contributions must be averaged over the same set of grid cells and hours in all years. Therefore, the 2002/2007 source contributions were averaged for the grid cells and hours when the 1999 ozone levels were 85 ppb or higher.

Table 7-10. Average ppb contributions[1] to high 8-hour ozone for 2002 (02base3).

5 NETAC Counties

Source Area	Source Category						
	PT	MV	OAN	BIO	BC	IC	Total
NETAC	8.8	8.3	9.3	0.2			26.7
NET11	6.0	0.9	2.7	0.2			9.8
SHRV	0.9	0.5	1.0	0.1			2.5
LA	1.2	0.7	1.5	0.2			3.5
AR	0.6	0.4	0.5	0.2			1.7
OK	0.4	0.4	0.4	0.1			1.2
DFW	0.2	0.6	0.5	0.1			1.4
HGBPA	0.2	0.1	0.2	0.0			0.5
TX	0.6	0.9	1.0	0.5			3.0
OTH	1.8	1.0	0.9	0.5			4.2
N/A					32.7	0.2	32.8
Total	20.6	13.8	18.1	2.1	32.7	0.2	87.3

Longview

Source Area	Source Category						
	PT	MV	OAN	BIO	BC	IC	Total
NETAC	12.1	11.4	12.4	0.2			36.1
NET11	3.4	0.6	2.3	0.1			6.4
SHRV	1.2	0.5	1.0	0.1			2.7
LA	1.3	0.7	1.5	0.3			3.8
AR	0.5	0.4	0.6	0.2			1.7
OK	0.3	0.2	0.3	0.1			0.8
DFW	0.1	0.4	0.4	0.1			1.0
HGBPA	0.2	0.1	0.1	0.0			0.5
TX	0.5	0.6	0.7	0.4			2.2
OTH	1.9	1.0	1.0	0.5			4.4
N/A					32.7	0.1	32.8
Total	21.4	16.0	20.3	1.9	32.7	0.1	92.4

Tyler

Source Area	Source Category						
	PT	MV	OAN	BIO	BC	IC	Total
NETAC	6.9	9.5	9.3	0.3			26.1
NET11	1.2	0.4	2.4	0.1			4.1
SHRV	1.4	0.5	1.1	0.1			3.1
LA	1.9	0.9	2.1	0.5			5.3
AR	1.4	0.9	1.2	0.5			4.0
OK	0.2	0.2	0.2	0.0			0.5
DFW	0.0	0.0	0.0	0.0			0.1
HGBPA	0.3	0.1	0.1	0.0			0.4
TX	0.2	0.3	0.6	0.1			1.2
OTH	2.0	1.2	1.3	0.8			5.4
N/A					32.3	0.0	32.3
Total	15.4	14.0	18.3	2.4	32.3	0.0	82.4

Cypress River

Source Area	Source Category						
	PT	MV	OAN	BIO	BC	IC	Total
NETAC	3.4	2.7	3.7	0.1			9.9
NET11	13.2	2.0	7.0	0.3			22.5
SHRV	0.9	0.7	1.4	0.1			3.0
LA	1.0	0.6	1.4	0.2			3.3
AR	1.1	0.6	0.8	0.3			2.8
OK	0.1	0.1	0.1	0.0			0.2
DFW	0.0	0.0	0.0	0.0			0.0
HGBPA	0.0	0.0	0.0	0.0			0.1
TX	1.2	1.8	2.6	0.3			5.9
OTH	1.5	0.8	0.7	0.4			3.5
N/A					33.0	0.1	33.0
Total	22.5	9.3	17.7	1.7	33.0	0.1	84.2

1. Contributions are averaged over all grid cells and hours that had 8-hour ozone of 85 ppb or higher in the 1999 base case.

Table 7-11. Average ppb contributions[1] to high 8-hour ozone for 2007 (07base5).

5 NETAC Counties

Source Area	Source Category						
	PT	MV	OAN	BIO	BC	IC	Total
NETAC	10.5	5.2	9.6	0.3			25.6
NET11	6.3	0.7	2.3	0.2			9.5
SHRV	0.9	0.4	1.2	0.1			2.5
LA	1.5	0.5	1.3	0.2			3.5
AR	0.4	0.3	0.6	0.2			1.5
OK	0.4	0.3	0.2	0.1			1.0
DFW	0.2	0.4	0.5	0.1			1.2
HGBPA	0.3	0.1	0.2	0.0			0.6
TX	1.0	0.6	0.9	0.5			3.0
OTH	1.0	0.7	1.3	0.5			3.6
N/A					32.6	0.2	32.8
Total	22.5	9.2	18.1	2.2	32.6	0.2	84.7

Longview

Source Area	Source Category						
	PT	MV	OAN	BIO	BC	IC	Total
NETAC	15.4	7.0	13.2	0.2			35.8
NET11	3.6	0.5	2.1	0.1			6.2
SHRV	1.0	0.4	1.2	0.1			2.6
LA	1.6	0.5	1.4	0.3			3.8
AR	0.5	0.3	0.6	0.2			1.6
OK	0.3	0.2	0.2	0.1			0.7
DFW	0.1	0.3	0.4	0.1			0.9
HGBPA	0.3	0.1	0.2	0.0			0.5
TX	0.8	0.5	0.7	0.4			2.3
OTH	1.1	0.7	1.4	0.6			3.8
N/A					32.6	0.1	32.8
Total	24.6	10.5	21.1	2.1	32.6	0.1	91.0

Tyler

Source Area	Source Category						
	PT	MV	OAN	BIO	BC	IC	Total
NETAC	8.2	6.6	9.5	0.3			24.6
NET11	1.5	0.3	2.3	0.1			4.2
SHRV	1.2	0.4	1.3	0.1			2.9
LA	2.5	0.6	2.1	0.5			5.7
AR	1.1	0.7	1.3	0.5			3.6
OK	0.2	0.1	0.1	0.0			0.5
DFW	0.0	0.0	0.0	0.0			0.1
HGBPA	0.3	0.1	0.1	0.0			0.5
TX	0.3	0.2	0.5	0.1			1.2
OTH	1.1	0.9	1.7	0.9			4.6
N/A					32.1	0.0	32.1
Total	16.5	10.0	18.8	2.5	32.1	0.0	79.9

Cypress River

Source Area	Source Category						
	PT	MV	OAN	BIO	BC	IC	Total
NETAC	4.0	1.7	3.7	0.1			9.5
NET11	14.6	1.5	4.5	0.3			20.9
SHRV	0.8	0.5	1.6	0.1			3.0
LA	1.3	0.5	1.2	0.2			3.3
AR	0.6	0.5	0.9	0.3			2.3
OK	0.1	0.0	0.0	0.0			0.2
DFW	0.0	0.0	0.0	0.0			0.0
HGBPA	0.1	0.0	0.0	0.0			0.1
TX	1.0	1.4	2.3	0.3			4.9
OTH	0.8	0.6	1.1	0.4			2.9
N/A					33.0	0.1	33.1
Total	23.3	6.7	15.4	1.8	33.0	0.1	80.3

1. Contributions are averaged over all grid cells and hours that had 8-hour ozone of 85 ppb or higher in the 1999 base case.

EMISSIONS CHANGES BETWEEN 1999, 2002 AND 2007

One of the outputs from a CAMx OSAT or APCA analysis is a summary of the emissions for each source grouping. Tables 7-4 to 7-6 show the emissions summaries for 1999, 2002 and 2007. Ratios of 2002/1999 emissions are shown in Table 7-7 and ratios of 2007/1999 emissions are shown in Table 7-8. These emission summaries are useful for comparison with the APCA source apportionment results but they are less accurate than the detailed emissions summaries reported in Section 3 for the following reasons. The emission summaries are all for the August 17th episode, other days may be different. These emissions summaries are prepared from the gridded emissions, and so areas are defined geographically to the nearest grid cell boundary, which means that emission totals may not exactly match those reported in Section 3. Finally, it is impossible to exactly calculate tons of VOCs from model ready inventories (because the model ready emissions are in moles, not tons) so the VOC emission totals will differ from those reported in Section 3.

Emissions Changes From 1999 to 2007

On-road mobile source emissions decreased over all by 33% for NOx and 38% for VOC between 1999 and 2007. These reductions result from improvements in vehicle technology and fuels in response to EPA rules for light-duty and heavy-duty vehicles (plus local measures in nonattainment areas). The vehicle technology and fuel improvements are partially offset by growth in VMT. Larger percentage reductions occurred in the DFW and HGBPA nonattainment areas than most of Texas due to local SIP measures. The largest percentage decrease in on-road mobile source NOx emissions was in the NETAC 5 county area due to a large decrease in NOx from truck traffic on Interstate-20. NOx emissions from heavy-duty trucks are projected to decrease significantly between 1999 and 2007 due to EPA regulations, and truck emissions make a relatively high contribution to on-road NOx in the NETAC area because I-20 runs across Smith, Gregg and Harrison Counties (see Figure 1-3). The Texas on-road mobile emissions were estimated by TTI for the TCEQ. All the on-road mobile source emissions are based on MOBILE6.

Point source emissions decreased over-all by 34% for NOx and 13% for VOC between 1999 and 2007. The largest percentage NOx reductions occurred in the states outside TX, LA, AR and OK and are due primarily to the effects of EPA's "NOx SIP call." NOx emissions in the NETAC 5 county area decreased by 22% (for August 17th) and NOx emissions in the surrounding 11 counties decreased by 24%. The decreases in Northeast Texas point source NOx result from NETAC measures included in the Northeast Texas 1-hour ozone SIP revision and TCEQ rules for Eastern Texas. The percentage decrease in point source NOx in Northeast Texas was larger than in the rest of Texas except for the DFW nonattainment area where deep point source NOx reductions are included in the SIP. The point source NOx reductions for the HGBPA nonattainment area are only 6% in these inventories but are expected to become greater as more Houston SIP rules are implemented. The percentage decrease in point source NOx in Northeast Texas also was larger than for LA and OK. The percent changes in point source VOC were highly variable and are not discussed. The point source emission changes for Northeast Texas were estimated by NETAC, for the remainder of Texas by TCEQ, and for all other areas by EPA.

Other anthropogenic (i.e., area plus off-road) emissions decreased over-all by 5% for NOx and 10% for VOC between 1999 and 2007. These over-all percentage reductions are smaller than for on-road mobile sources and point sources. In the NETAC 5 county area, other anthropogenic NOx emissions decreased by 2% and other anthropogenic VOC increased by 4% because the effects of growth offset the effects of controls. All the off-road source emissions were based on the EPA's NONROAD2002 model.

There were no changes in the biogenic emissions between 1999 and 2007.

Emissions Changes From 1999 to 2002

The changes in NETAC area NOx emissions for 2002 and 20007 relative to 1999 are as follows. On-road mobile NOx decreased by 16% in 2002 and 52% in 2007. The 2007 decrease is greater because EPA's heavy-duty vehicle NOx reductions phase-in more strongly after 2002. Point source NOx decreased by 32% in 2002 and 22% in 2007. The smaller decrease for 2002 than 2007 results from the way the emissions were estimated. NETAC area EGU emissions were based on July-September average actual emissions for 2002 whereas for 2007 they were episodic values assuming high heat input rates and permit-limit emission factors. Thus, the higher NETAC point-source emissions for 2007 than 2002 do not indicate an expected real-world increase in emissions, and this assumption will have a conservative effect in the 8-hour ozone attainment demonstration. Other anthropogenic NOx increased by 1% in 2002 and decreased by 2% in 2007

The changes in over-all NOx emissions for 2002 and 20007 relative to 1999 are as follows. On-road mobile NOx decreased 6% in 2002 and 33% in 2007. The 2007 decrease is greater because EPA's heavy-duty vehicle NOx reductions phase-in more strongly after 2002. Point-source NOx decreased 21% in 2002 and 34% in 2007. The 2007 decrease is greater primarily due to the phase-in of EPA's "NOx SIP call." Other anthropogenic NOx decreased by 8% in 2002 and 5% in 2007.

CHANGES IN OZONE BETWEEN 1999 AND 2007

The changes in ozone contributions between 1999, 2002 and 2007 are shown in Tables 7-10 and 7-11 and are illustrated using bar charts in Figure 7-4. The discussion of these results is limited to the changes from 1999 to 2007 to focus on the attainment demonstration year.

NETAC 5 County Area

For the NETAC 5 county area the total reduction in high 8-hour ozone was –8.1 ppb (Table 7-13, top left). There were reduced contributions from on-road mobile source NOx (–5.4 ppb) and point source NOx (–3.86 ppb) but a small increase in the contribution of other anthropogenic NOx (0.6 ppb).

Looking at the geographic contributions to ozone reductions, the largest reductions were from the NETAC area (–3.8 ppb) and the 11 counties surrounding NETAC (–2.0 ppb) with smaller reductions from other areas. These combined reductions from the NETAC area and surrounding 11 counties accounted for 72% of the total reduction of –8.1 ppb.

Looking in detail at the ozone reductions from emissions sources in Northeast Texas, the largest reductions were from on-road mobile sources (–4.0 ppb) and point sources (–0.8 ppb), which is consistent with the NOx emissions reductions for these categories shown in Table 7-8. The ozone contribution from other anthropogenic NOx emissions increased by 1.0 ppb even though the emissions decreased slightly (2%, Table 7-8). This is a consequence of the non-linear relationship between ozone and NOx emissions whereby reducing NOx from point and on-road mobile source emissions causes more efficient ozone formation from the remaining other anthropogenic NOx.

Longview

The total reduction in high 8-hour ozone at Longview (–6.1 ppb, Table 7-13, top right) was smaller than for the NETAC 5 county area. This is partly because the decreases in contributions of local on-road mobile source NOx emissions (–5.2 ppb) and local point source NOx emissions (–0.6 ppb) were offset by increase in the contributions from local other anthropogenic NOx emissions (2.0 ppb).

Tyler

The total reduction in high 8-hour ozone was –5.9 ppb at Tyler (Table 7-13, bottom left), which was smaller than the total reductions for the NETAC 5 county area and for Longview. The reduction in ozone from Northeast Texas emissions was –3.2 ppb, which was entirely due to reductions from on-road mobile sources of –3.9 ppb.

Cypress River

The total reduction in high 8-hour ozone was –14.7 ppb at Cypress River (Table 7-13, bottom right), which was much larger than for the other receptor areas. This large reduction was due to a large decrease of –10.1 ppb in the contribution of point source NOx in the 11 counties surrounding NETAC. This is related to the proximity of the Cypress River monitor to utility point sources in Titus County (Monticello and Welsh) and Marion County (Wilkes). The emissions reductions at these sources (from Section 3) are Monticello (76%), Welsh (57%) and Wilkes (50%) averaged over all episode days.

Table 7-12. Change in average contributions to high 8-hour ozone between 1999 (base7) and 2002 (02base3).

5 NETAC Counties

Source Area	Source Category						
	PT	MV	OAN	BIO	BC	IC	Total
NETAC	-2.5	-0.9	0.7	0.0			-2.7
NET11	-1.8	0.0	0.1	0.0			-1.7
SHRV	-0.1	0.0	0.0	0.0			-0.1
LA	-0.1	0.0	0.0	0.0			-0.1
AR	0.0	0.0	-0.1	0.0			-0.1
OK	-0.1	0.0	0.0	0.0			-0.1
DFW	-0.1	0.0	0.0	0.0			-0.1
HGBPA	0.0	0.0	0.0	0.0			0.0
TX	-0.4	0.0	0.0	0.0			-0.4
OTH	-0.3	0.0	-0.1	0.0			-0.4
N/A					0.1	0.0	0.1
Total	-5.5	-0.9	0.6	0.1	0.1	0.0	-5.5

Longview

Source Area	Source Category						
	PT	MV	OAN	BIO	BC	IC	Total
NETAC	-3.9	-0.9	1.3	0.0			-3.5
NET11	-0.7	0.0	0.1	0.0			-0.6
SHRV	-0.1	0.0	0.0	0.0			0.0
LA	-0.1	0.0	0.0	0.0			-0.1
AR	0.0	0.0	-0.1	0.0			-0.1
OK	-0.1	0.0	0.0	0.0			0.0
DFW	0.0	0.0	0.0	0.0			0.0
HGBPA	0.0	0.0	0.0	0.0			0.0
TX	-0.3	0.0	0.0	0.0			-0.3
OTH	-0.4	0.0	0.0	0.0			-0.4
N/A					0.4	0.0	0.4
Total	-5.5	-0.9	1.3	0.1	0.4	0.0	-4.7

Tyler

Source Area	Source Category						
	PT	MV	OAN	BIO	BC	IC	Total
NETAC	-1.2	-1.0	0.3	0.0			-1.8
NET11	-0.1	0.0	0.0	0.0			-0.2
SHRV	-0.1	0.0	0.0	0.0			-0.1
LA	-0.2	-0.1	0.0	0.0			-0.2
AR	0.0	0.0	-0.2	0.0			-0.2
OK	0.0	0.0	0.0	0.0			0.0
DFW	0.0	0.0	0.0	0.0			0.0
HGBPA	0.0	0.0	0.0	0.0			0.0
TX	0.0	0.0	0.0	0.0			-0.1
OTH	-0.6	0.0	-0.1	0.0			-0.6
N/A					-0.1	0.0	-0.1
Total	-2.3	-1.1	-0.1	0.1	-0.1	0.0	-3.4

Cypress River

Source Area	Source Category						
	PT	MV	OAN	BIO	BC	IC	Total
NETAC	-1.2	-0.3	0.3	0.0			-1.1
NET11	-8.6	0.1	-0.1	0.0			-8.6
SHRV	-0.2	0.0	0.0	0.0			-0.2
LA	-0.1	0.0	0.0	0.0			-0.1
AR	0.0	0.0	-0.2	0.0			-0.2
OK	0.0	0.0	0.0	0.0			0.0
DFW	0.0	0.0	0.0	0.0			0.0
HGBPA	0.0	0.0	0.0	0.0			0.0
TX	0.0	0.1	-0.1	0.0			0.0
OTH	-0.3	0.0	-0.1	0.0			-0.4
N/A					-0.3	0.0	-0.3
Total	-10.4	-0.1	-0.1	0.1	-0.3	0.0	-10.8

Note: Contributions are averaged over all grid cells and hours that had 8-hour ozone of 85 ppb or higher in the 1999 base case. Negative values mean a smaller contribution in 2002 than 1999.

Table 7-13. Change in average contributions to high 8-hour ozone between 1999 (base7) and 2007 (07base5).

5 NETAC Counties

Source Area	Source Category						
	PT	MV	OAN	BIO	BC	IC	Total
NETAC	-0.8	-4.0	1.0	0.0			-3.8
NET11	-1.5	-0.2	-0.3	0.0			-2.0
SHRV	-0.1	-0.1	0.2	0.0			-0.1
LA	0.2	-0.2	-0.2	0.0			-0.2
AR	-0.2	-0.1	0.0	0.0			-0.3
OK	0.0	-0.1	-0.2	0.0			-0.3
DFW	-0.1	-0.2	0.0	0.0			-0.2
HGBPA	0.0	-0.1	0.0	0.0			0.0
TX	-0.1	-0.2	-0.1	0.0			-0.4
OTH	-1.1	-0.3	0.3	0.1			-1.0
N/A					0.1	0.0	0.1
Total	-3.6	-5.4	0.6	0.2	0.1	0.0	-8.1

Longview

Source Area	Source Category						
	PT	MV	OAN	BIO	BC	IC	Total
NETAC	-0.6	-5.2	2.0	0.0			-3.7
NET11	-0.5	-0.1	-0.1	0.0			-0.8
SHRV	-0.2	-0.1	0.2	0.0			-0.1
LA	0.2	-0.2	-0.2	0.0			-0.1
AR	-0.1	-0.1	0.0	0.0			-0.1
OK	0.0	-0.1	-0.1	0.0			-0.2
DFW	0.0	-0.1	0.0	0.0			-0.2
HGBPA	0.0	0.0	0.0	0.0			0.0
TX	0.0	-0.2	-0.1	0.0			-0.2
OTH	-1.2	-0.3	0.3	0.1			-1.0
N/A					0.4	0.0	0.4
Total	-2.3	-6.4	2.1	0.3	0.3	0.0	-6.1

Tyler

Source Area	Source Category						
	PT	MV	OAN	BIO	BC	IC	Total
NETAC	0.1	-3.9	0.5	0.0			-3.2
NET11	0.1	-0.1	-0.1	0.0			-0.1
SHRV	-0.3	-0.1	0.1	0.0			-0.3
LA	0.5	-0.3	-0.1	0.0			0.2
AR	-0.3	-0.3	0.0	0.1			-0.6
OK	0.0	-0.1	-0.1	0.0			-0.1
DFW	0.0	0.0	0.0	0.0			0.0
HGBPA	0.0	0.0	0.0	0.0			0.0
TX	0.1	-0.1	-0.1	0.0			-0.1
OTH	-1.5	-0.3	0.3	0.1			-1.4
N/A					-0.3	0.0	-0.3
Total	-1.2	-5.2	0.5	0.2	-0.3	0.0	-5.9

Cypress River

Source Area	Source Category						
	PT	MV	OAN	BIO	BC	IC	Total
NETAC	-0.7	-1.2	0.4	0.0			-1.5
NET11	-7.2	-0.4	-2.5	0.0			-10.1
SHRV	-0.2	-0.2	0.2	0.0			-0.2
LA	0.3	-0.2	-0.2	0.0			-0.1
AR	-0.5	-0.2	-0.1	0.0			-0.7
OK	0.0	0.0	-0.1	0.0			0.0
DFW	0.0	0.0	0.0	0.0			0.0
HGBPA	0.0	0.0	0.0	0.0			0.0
TX	-0.2	-0.3	-0.5	0.0			-0.9
OTH	-1.1	-0.2	0.3	0.1			-0.9
N/A					-0.2	0.0	-0.2
Total	-9.6	-2.7	-2.4	0.2	-0.2	0.0	-14.7

Note: Contributions are averaged over all grid cells and hours that had 8-hour ozone of 85 ppb or higher in the 1999 base case. Negative values mean a smaller contribution in 2007 than 1999.

Source Category **Source Area**

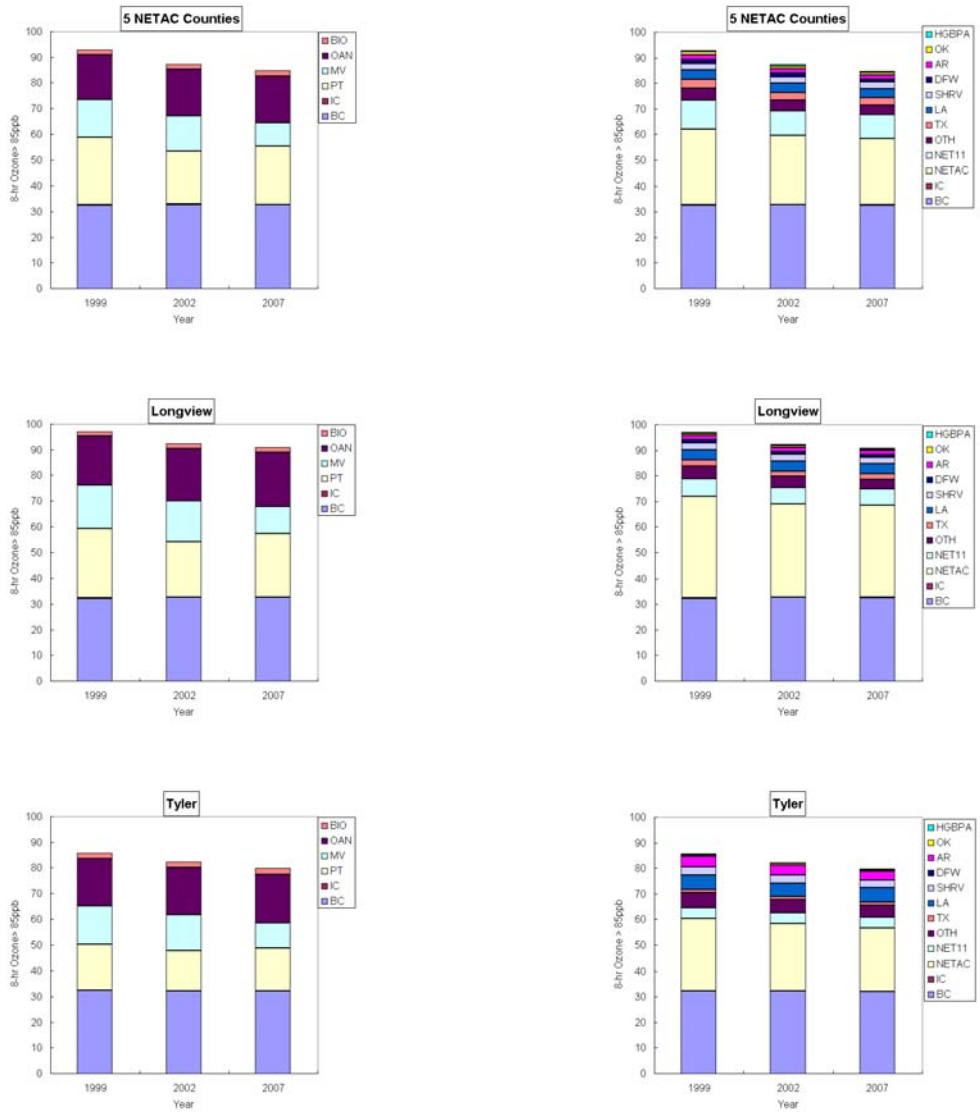


Figure 7-4. Comparison of 1999, 2002 and 2007 average ppb contributions to 8-hour ozone of 85 ppb and higher.

SUMMARY AND CONCLUSIONS

The ozone source apportionment analysis provides insight into the sensitivity of modeled ozone levels to emissions, boundary conditions and initial conditions in 1999 and 2007. This information leads to the following conclusions about the model configuration, the sources that contribute to high ozone and the effectiveness of emissions reductions.

Model Configuration

- Initial conditions were unimportant. This shows that the model spin-up period was sufficient.

- Boundary conditions contributed about 33 ppb to 8-hour ozone levels above 85 ppb in Northeast Texas in 1999, 2002 and 2007. Since the boundary condition for ozone was set to 40 ppb, about 25% of the boundary ozone was destroyed by chemistry and deposition before reaching Northeast Texas. This level of influence from the boundary conditions is appropriate and shows that the modeling is not overly influenced by boundary condition assumptions. The boundary influence is constant across years because the boundary conditions were held constant.

- Emissions in states outside of Texas, Louisiana, Arkansas and Oklahoma contributed about 4 ppb to 8-hour ozone above 85 ppb in Northeast Texas. This contribution is about 5% of the high 8-hour ozone which shows that:

  - High 8-hour ozone levels in Northeast Texas during this episode were primarily due to emissions from within a “1-state” distance upwind.

  - The 12-km modeling domain is large enough to capture most of the important upwind emissions influence from Texas, Louisiana, Arkansas and Oklahoma.

- Emissions from Northeast Texas (NETAC 5 counties plus the surrounding 11 counties) and Shreveport contributed about 44 ppb of 8-hour ozone above 85 ppb in Northeast Texas in 1999. This shows that the 4-km modeling domain is large enough to capture more than 50% of the important emissions influences.

Ozone Sensitivity to Emissions

- The majority (more than 62%) of high 8-hour ozone in the NETAC 5 county area in 1999 was attributed to anthropogenic emissions sources. This means that 8-hour ozone can be reduced by controlling the appropriate emissions sources.

- Controlling NOx emissions is the only effective strategy for reducing high 8-hour ozone. Ozone formation is predominantly NOx sensitive on moderately high 8-hour ozone days, but on the highest ozone days (i.e., with the most stagnant meteorology) ozone is sensitive to both NOx and VOCs. However, because the VOCs are dominated by biogenic emissions, NOx control is the most effective strategy on all days. Emissions of highly reactive VOCs close to a monitor may be an exceptional case.

Source Contributions in 1999

- The largest emissions contributions to high 8-hour ozone in the NETAC 5 county area come from nearby NOx emissions. Nearby means primarily emissions from within the 5 county NETAC area, followed by emissions in surrounding counties, followed by emissions from

Louisiana. The contribution from Louisiana is split about evenly between the 4 parish Shreveport area and the rest of the state.

- The relative importance of different source categories of NOx emission varies by location within the NETAC area. For the 5 county region as a whole and for Longview and Cypress River, point sources are the largest contributor followed by area/off-road sources followed by motor vehicles. At Tyler, area/off-road sources are the largest contributor followed by point sources followed by motor vehicles.

- The contribution to high 8-hour ozone in the NETAC 5 county area from emissions in the 5 Counties was 29.4 ppb and from the surrounding 11 Counties was 11.5 ppb.

- The contribution to high 8-hour ozone in the NETAC 5 county area from Dallas/Fort Worth was 1.5 ppb, from Houston/Galveston/Beaumont/Port Arthur was 0.6 ppb and from the rest of Texas was 3.4 ppb.

- The contribution to high 8-hour ozone in the NETAC 5 county area from Shreveport was 2.6 ppb, the rest of Louisiana was 3.7 ppb, Arkansas was 1.8 ppb and Oklahoma was 1.3 ppb.

- The contribution to high 8-hour ozone in the NETAC 5 county area from states outside Texas, Louisiana, Arkansas and Oklahoma was 4.4 ppb.

Emissions Changes between 1999 and 2007

Emissions changes were analyzed for the August 17th episode day and may be different for other episode days.

- NOx emissions in the NETAC 5 county area decreased by –52% for on-road mobile sources and –22% for point sources and –2% for other anthropogenic sources (area plus off-road).

Ozone Changes between 1999 and 2007

- High 8-hour ozone in the NETAC 5 county area was reduced by –8.1 ppb between 1999 and 2007. There were reduced contributions from point source NOx (–3.6 ppb) and on-road mobile source NOx (–5.4 ppb) but a small increase in the contribution of other anthropogenic NOx (0.6 ppb).

- The 0.6 ppb increase in the ozone contribution from other anthropogenic NOx emissions is explained by more efficient ozone formation from NOx emissions as total NOx levels are reduced. This is an example of the non-linear relationship between ozone and NOx emissions.

- The non-linear relationship between ozone and NOx is most pronounced in areas with relatively high NOx emissions, such as the Longview monitor area. The consequence is that high 8-hour ozone levels at Longview are resistant to NOx reductions, even though NOx reduction is the most effective strategy. In other words, an X% reduction in local NOx emissions will lead to less than an X% reduction in ozone at Longview.

- The contribution to high 8-hour ozone in the NETAC 5 county area from the rest of Texas (i.e., outside the 16 counties in Northeast Texas) decreased by –0.6 ppb.

- There were small changes between 1999 and 2007 in the contributions to high 8-hour ozone in the NETAC 5 county area from Shreveport (–0.1 ppb), the rest of Louisiana (–0.2 ppb), Arkansas (–0.3 ppb) and Oklahoma (–0.3 ppb).

- Although the contribution of emissions from states outside Texas, Louisiana, Arkansas and Oklahoma was small (4.6ppb in 1999), this contribution was reduced by –1.0 ppb in 2007 showing benefits from emissions reductions strategies for the Eastern U.S. such as EPA's "NOx SIP call" and cleaner on-road vehicles and fuels.

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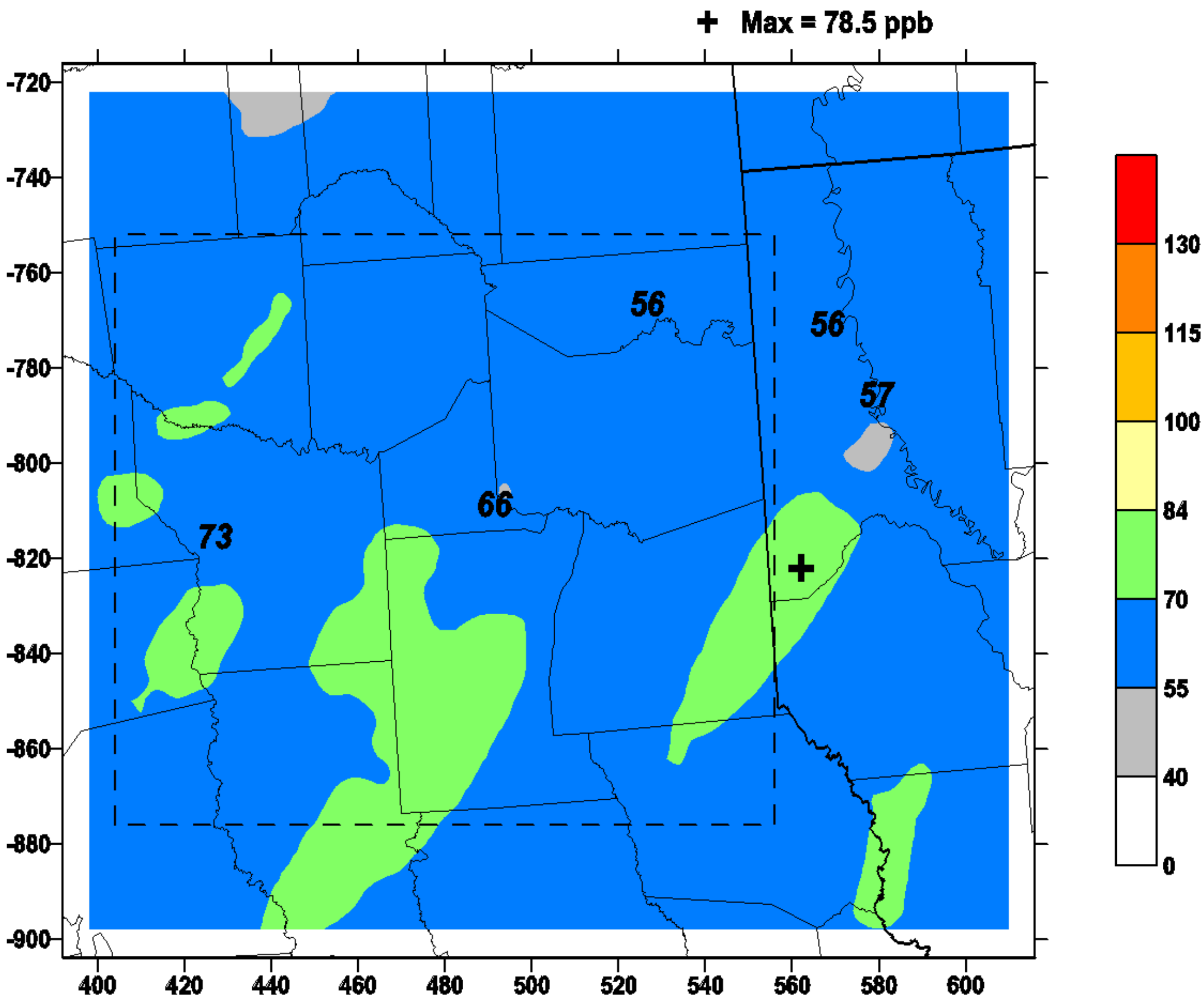
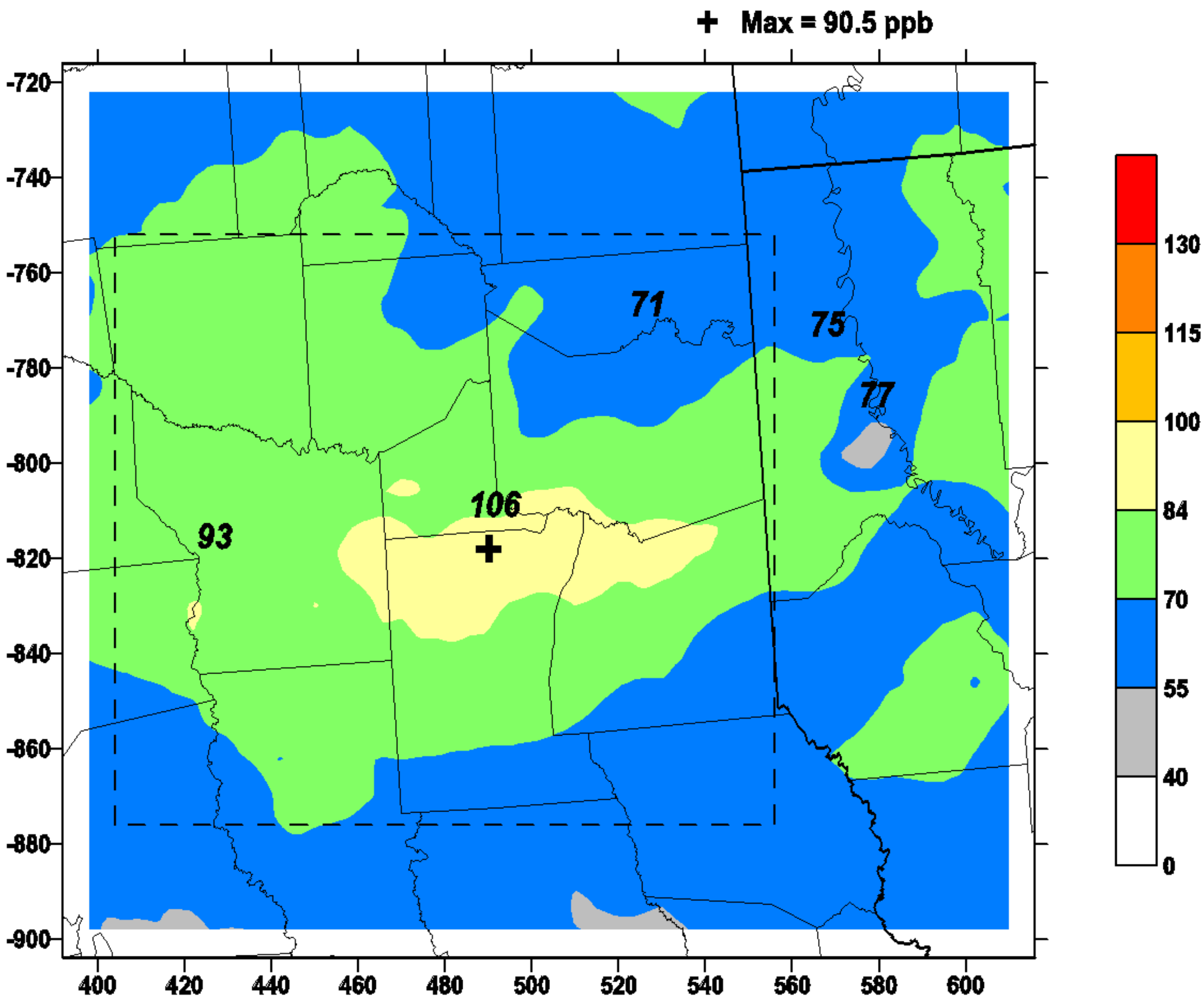
Appendix A

Spatial Maps of Estimated and Observed
Daily Maximum 8-Hour Ozone (ppb)
in the 4-km Grid
For the August 15–22, 1999 Episode:

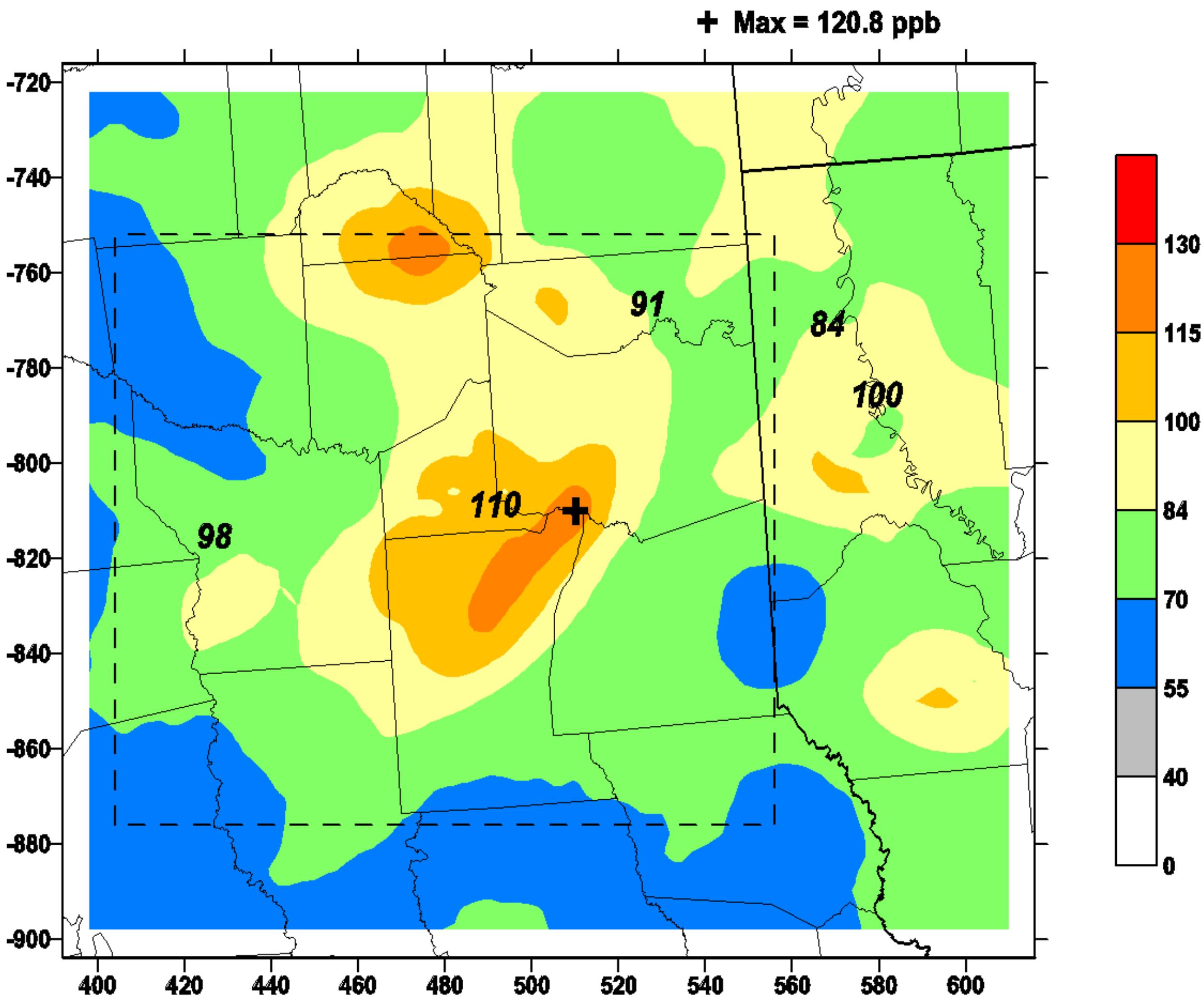
1999 Base Case 7



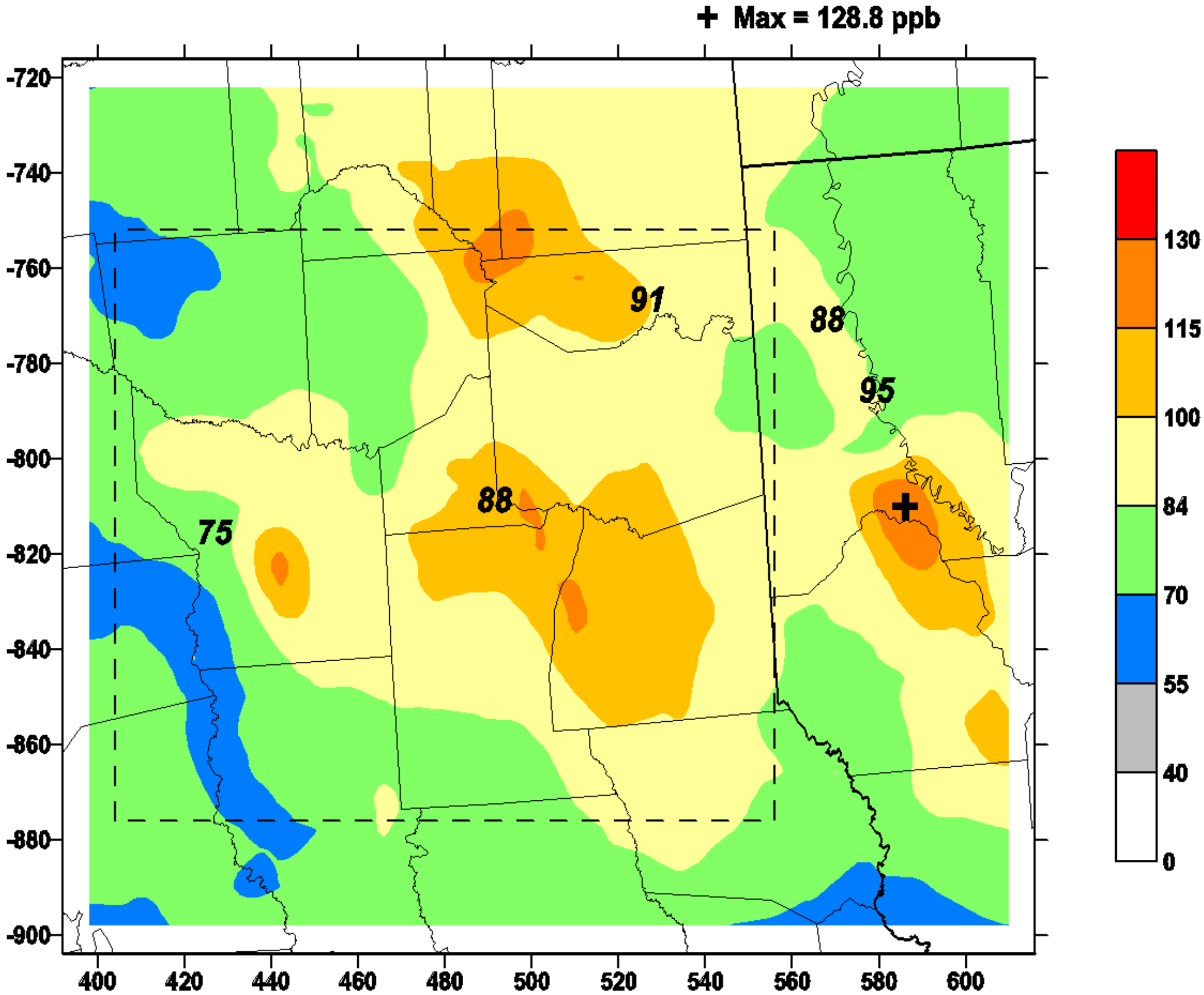
Daily Max 8-Hour Ozone(ppb)
1999 base7
August 15, 1999



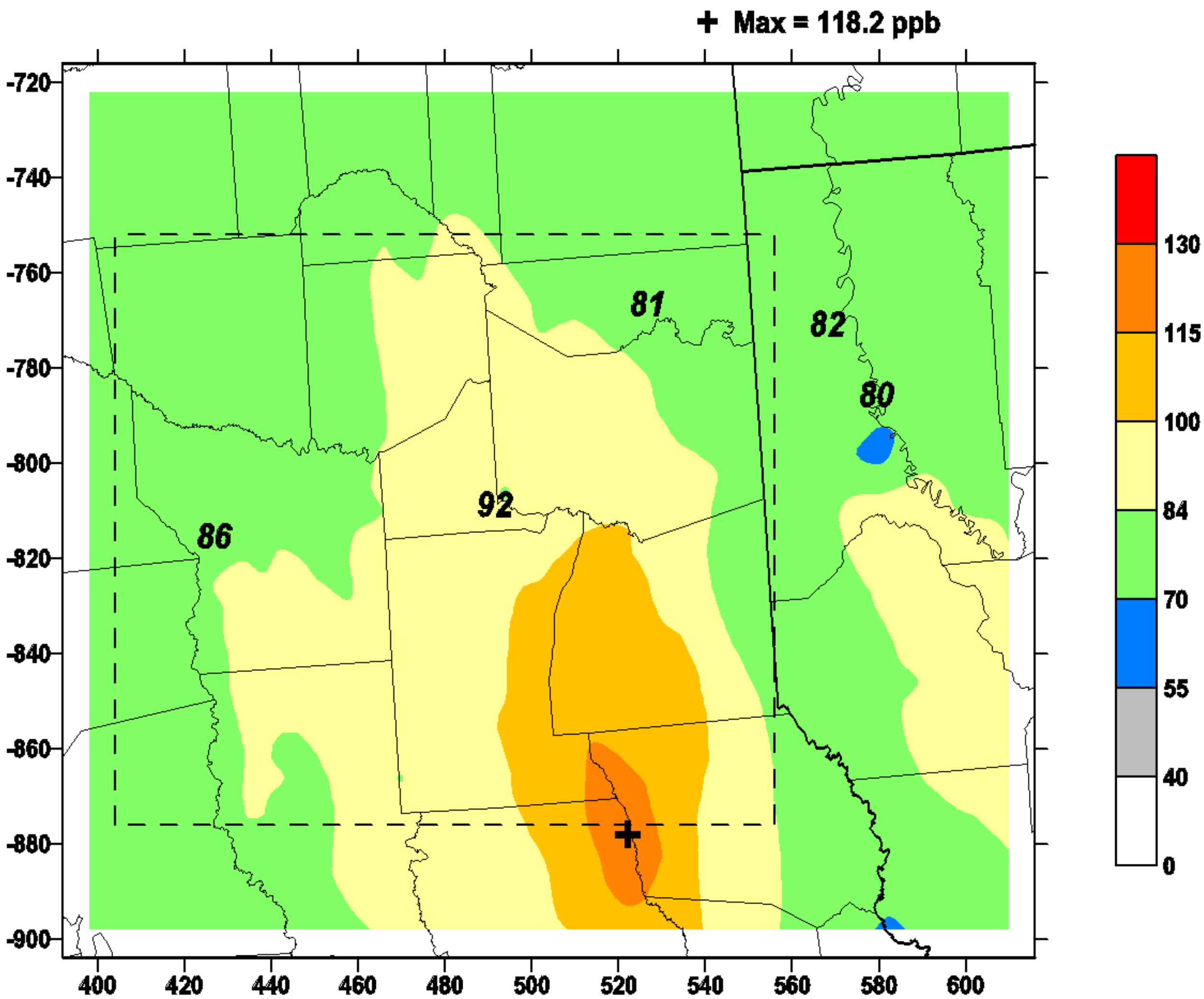
Daily Max 8-Hour Ozone(ppb)
1999 base7
August 16, 1999



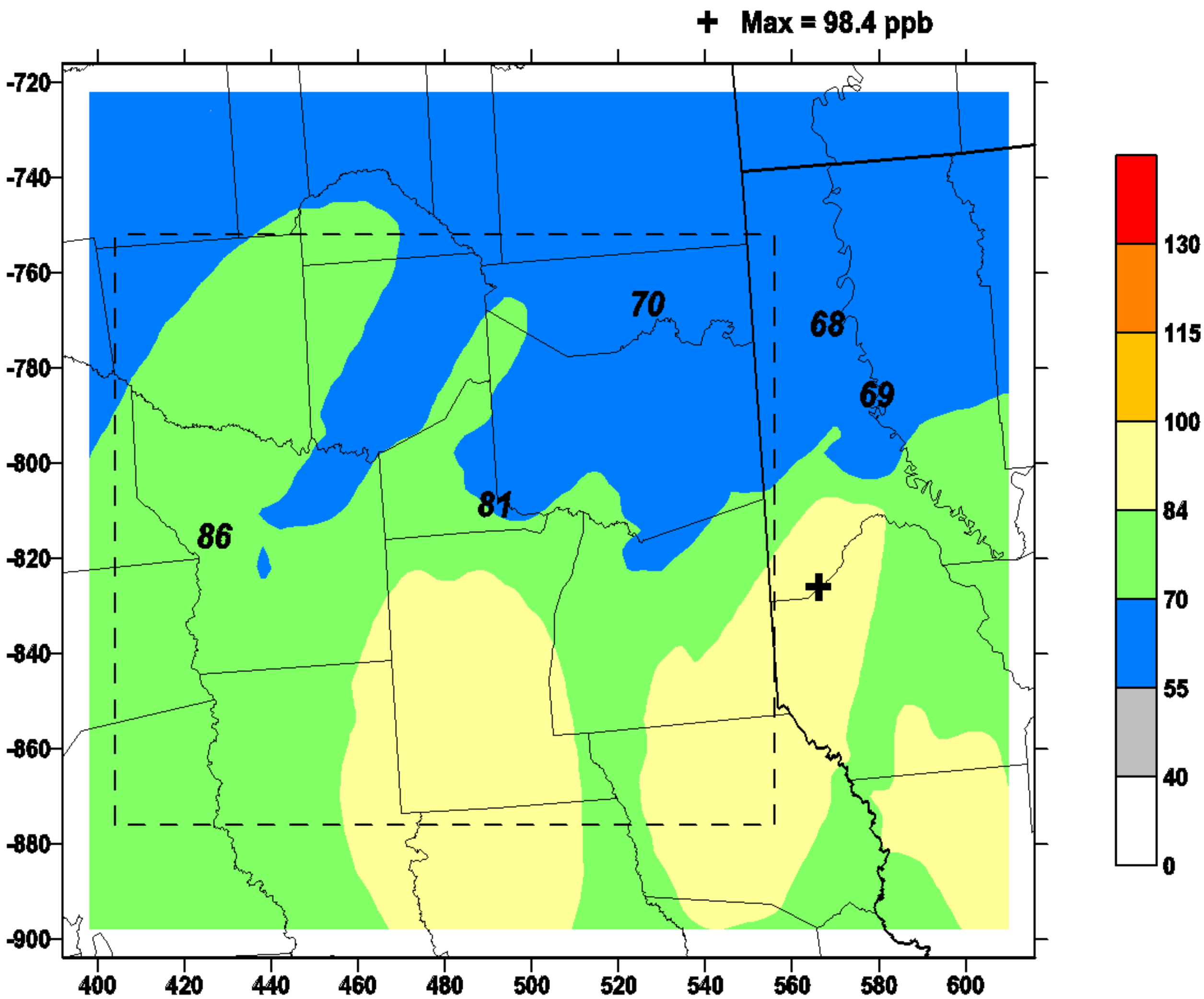
Daily Max 8-Hour Ozone(ppb)
1999 base7
August 17, 1999



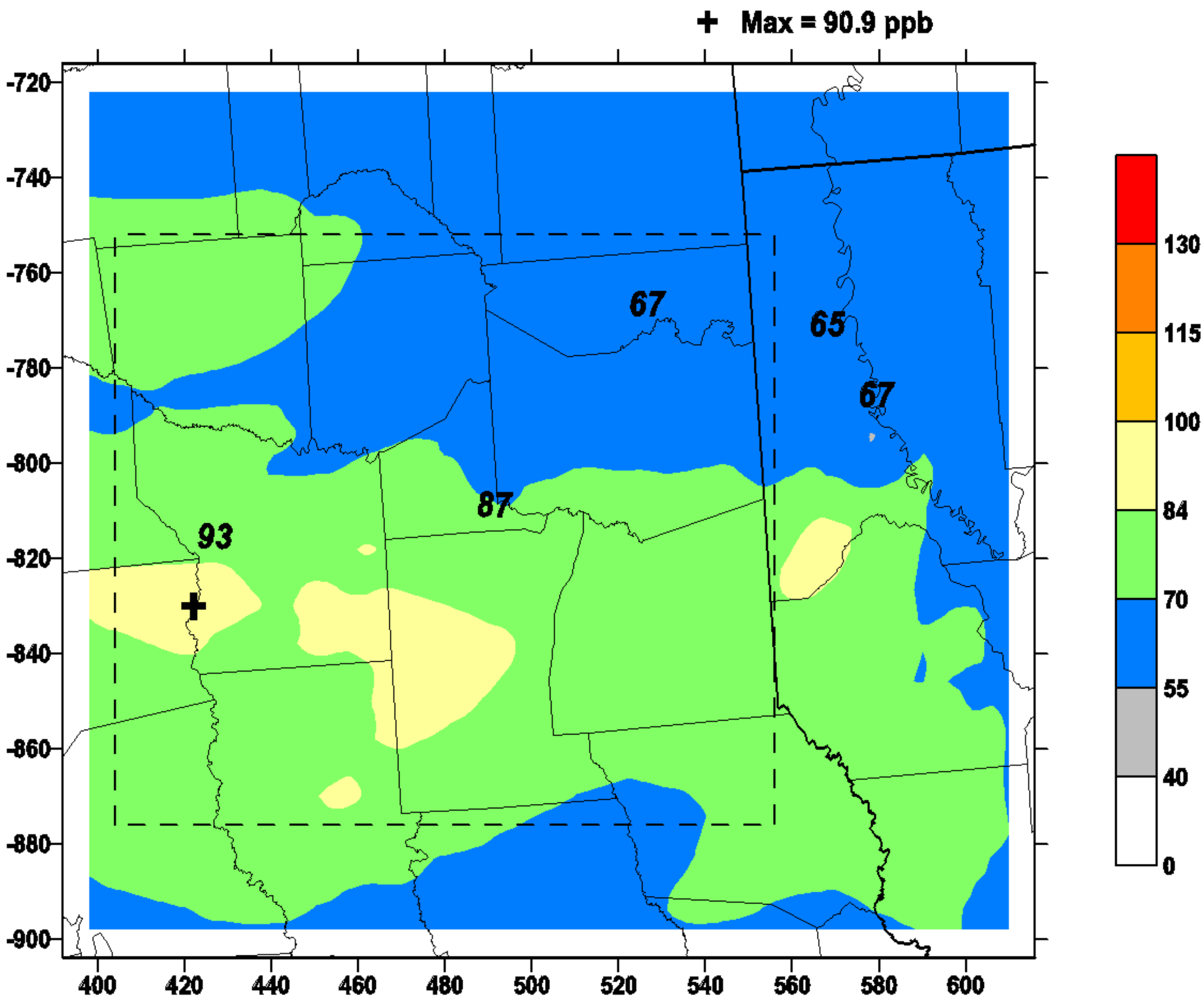
Daily Max 8-Hour Ozone(ppb)
1999 base7
August 18, 1999



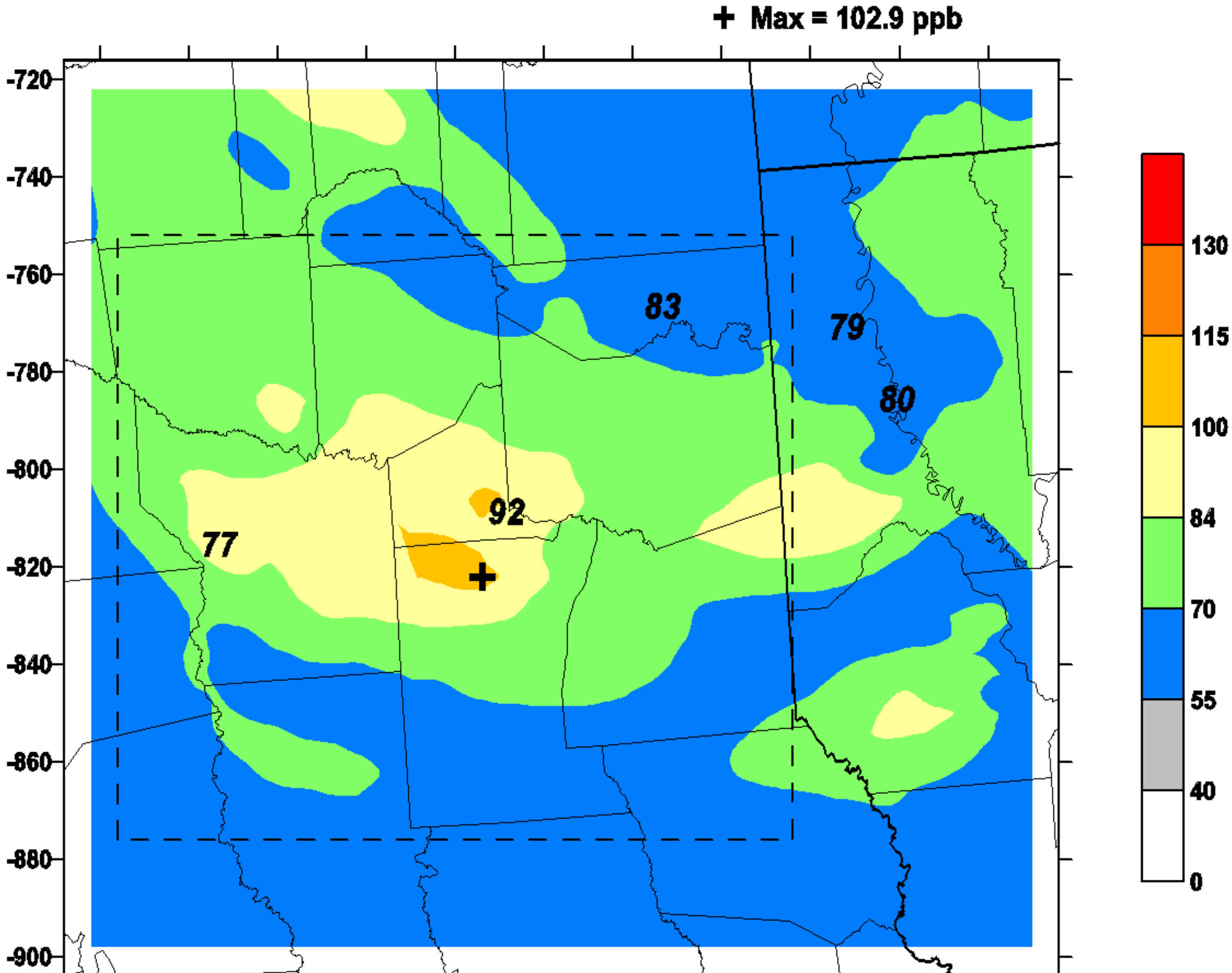
Daily Max 8-Hour Ozone(ppb)
1999 base7
August 19, 1999



Daily Max 8-Hour Ozone(ppb)
1999 base7
August 20, 1999



Daily Max 8-Hour Ozone(ppb)
1999 base7
August 21, 1999

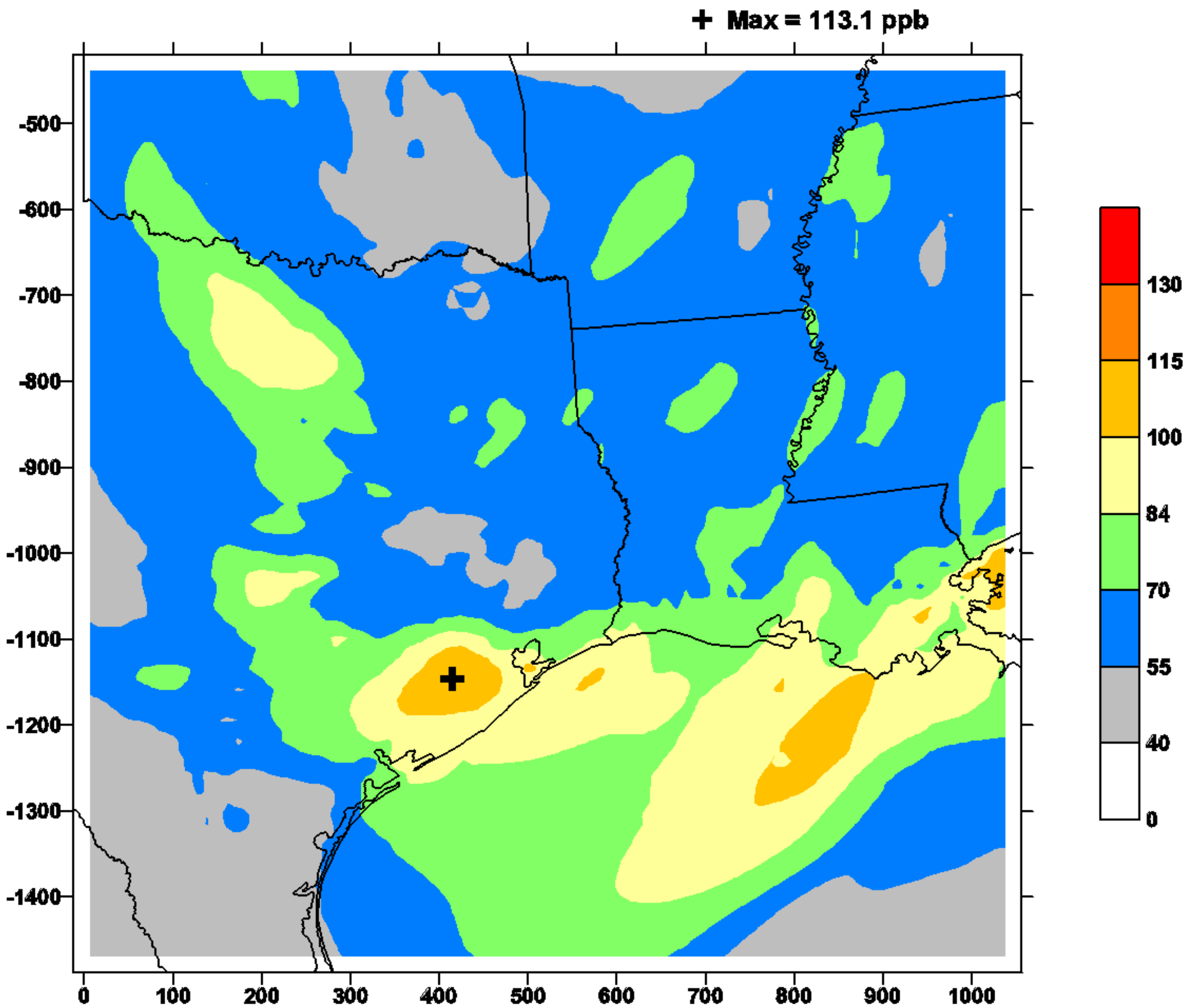


Daily Max 8-Hour Ozone(ppb)
1999 base7
August 22, 1999

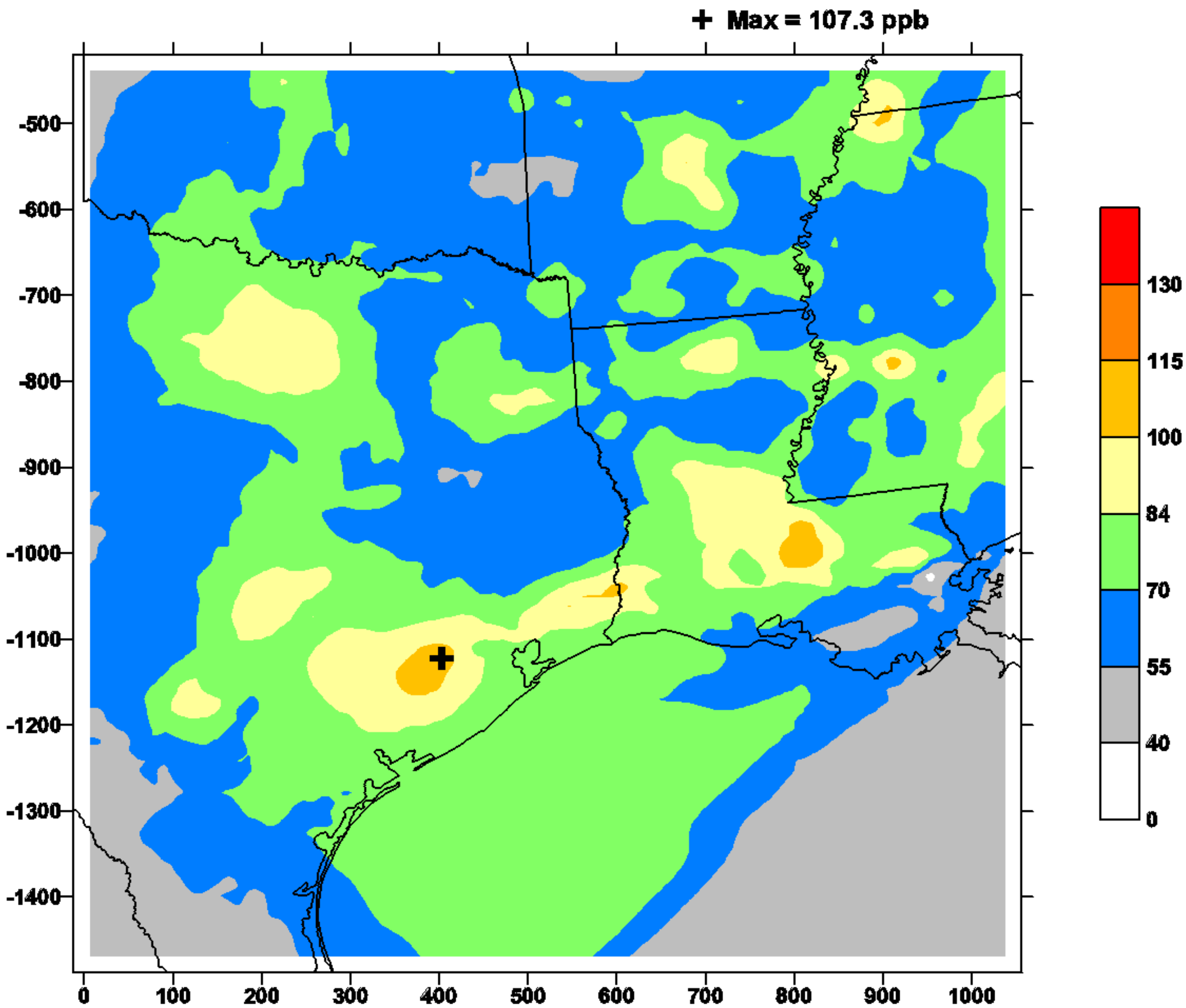
Appendix B

Spatial Maps of Estimated
Daily Maximum 8-Hour Ozone (ppb)
in the 12-km Grid
For the August 15–22, 1999 Episode:

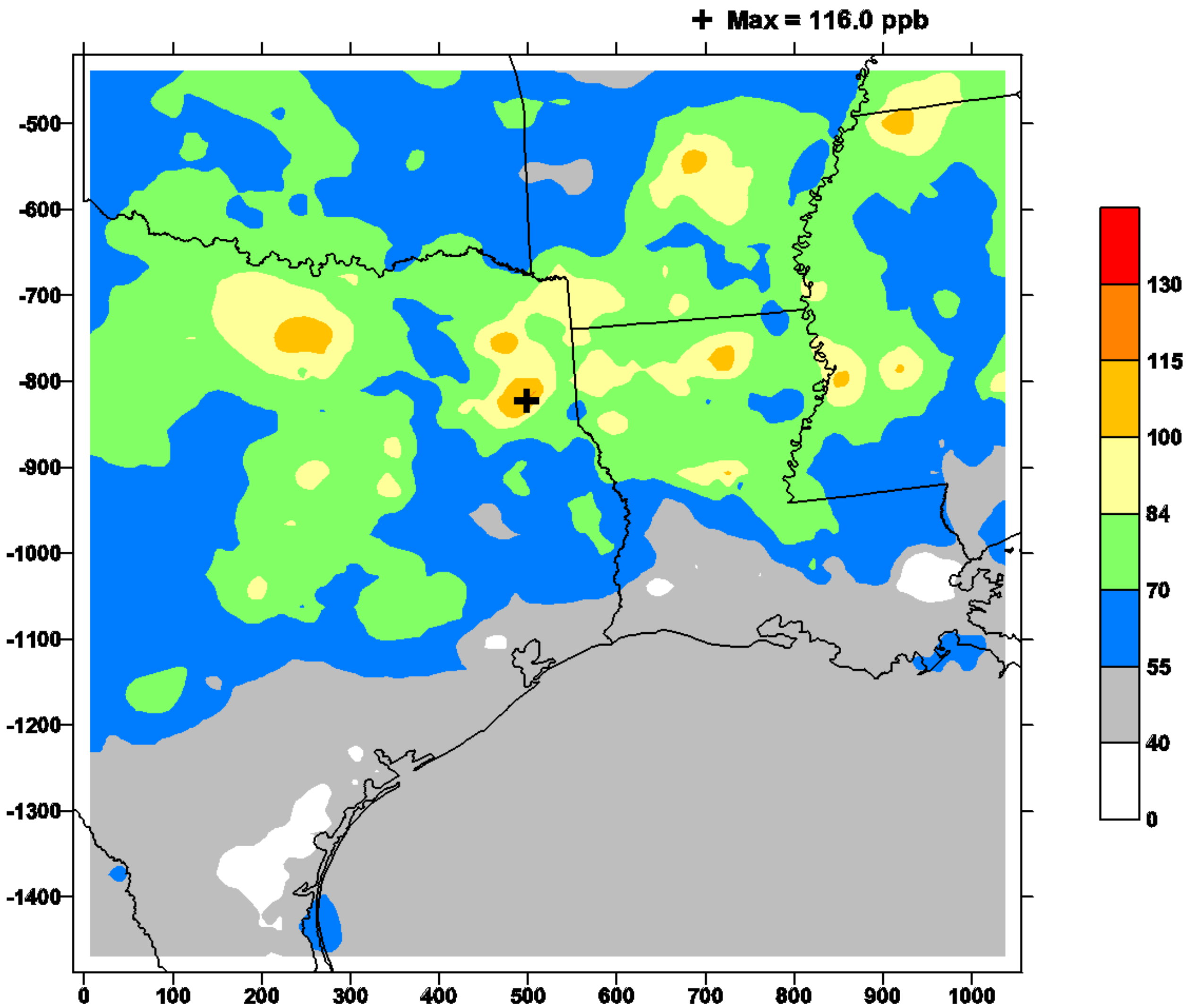
1999 Base Case 7



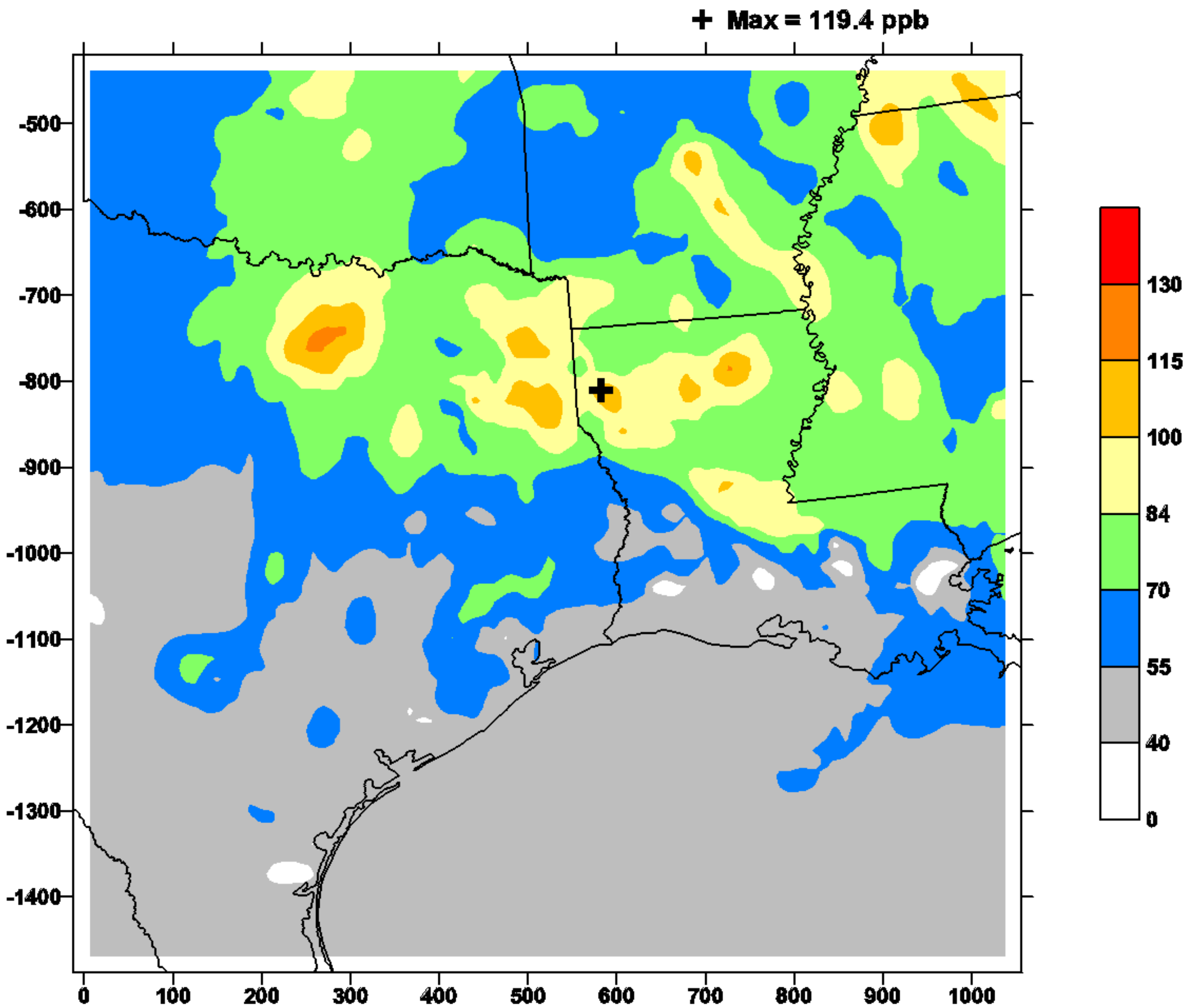
Daily Max 8-Hour Ozone(ppb)
1999 base7
August 15, 1999



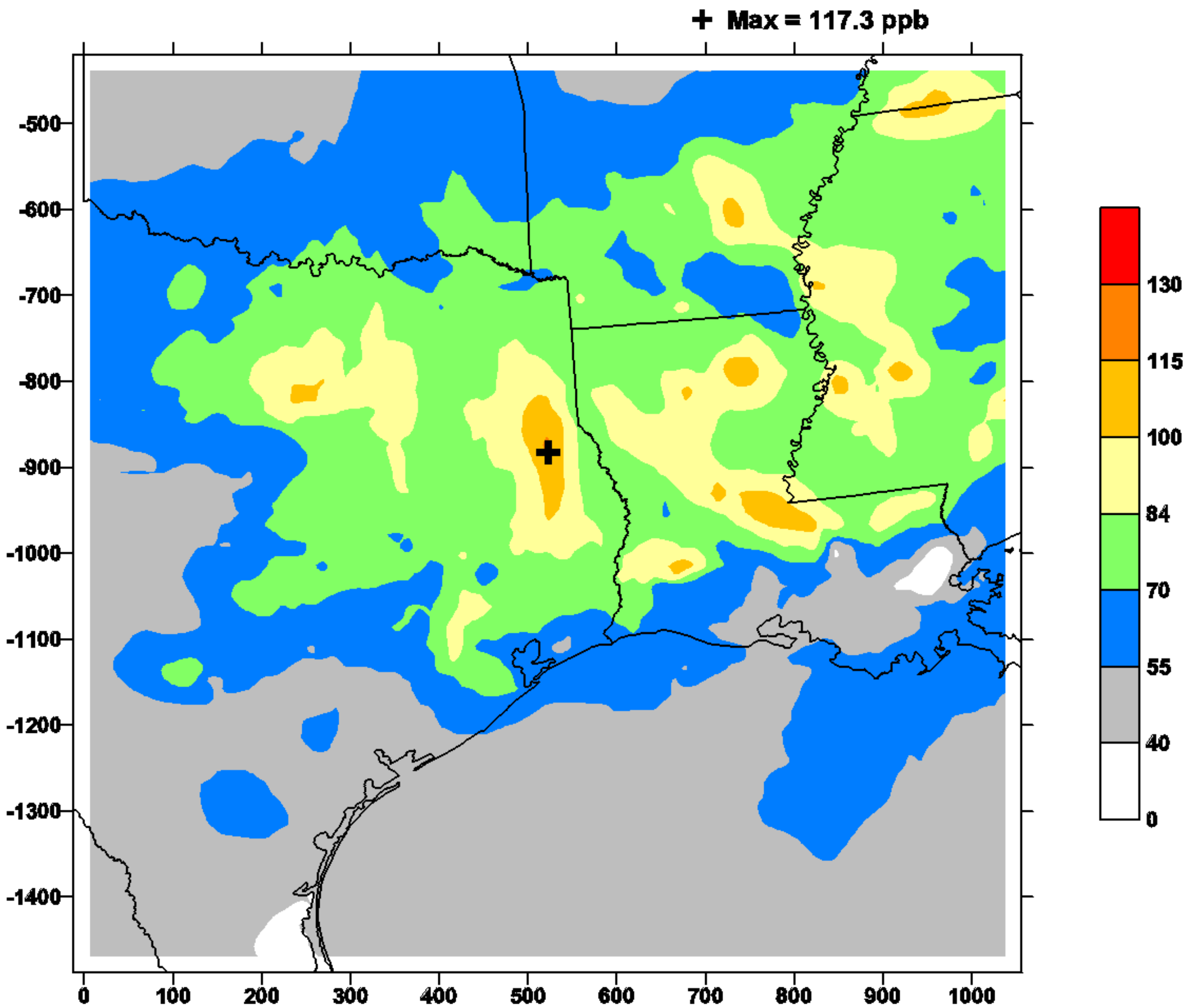
Daily Max 8-Hour Ozone(ppb)
1999 base7
August 16, 1999



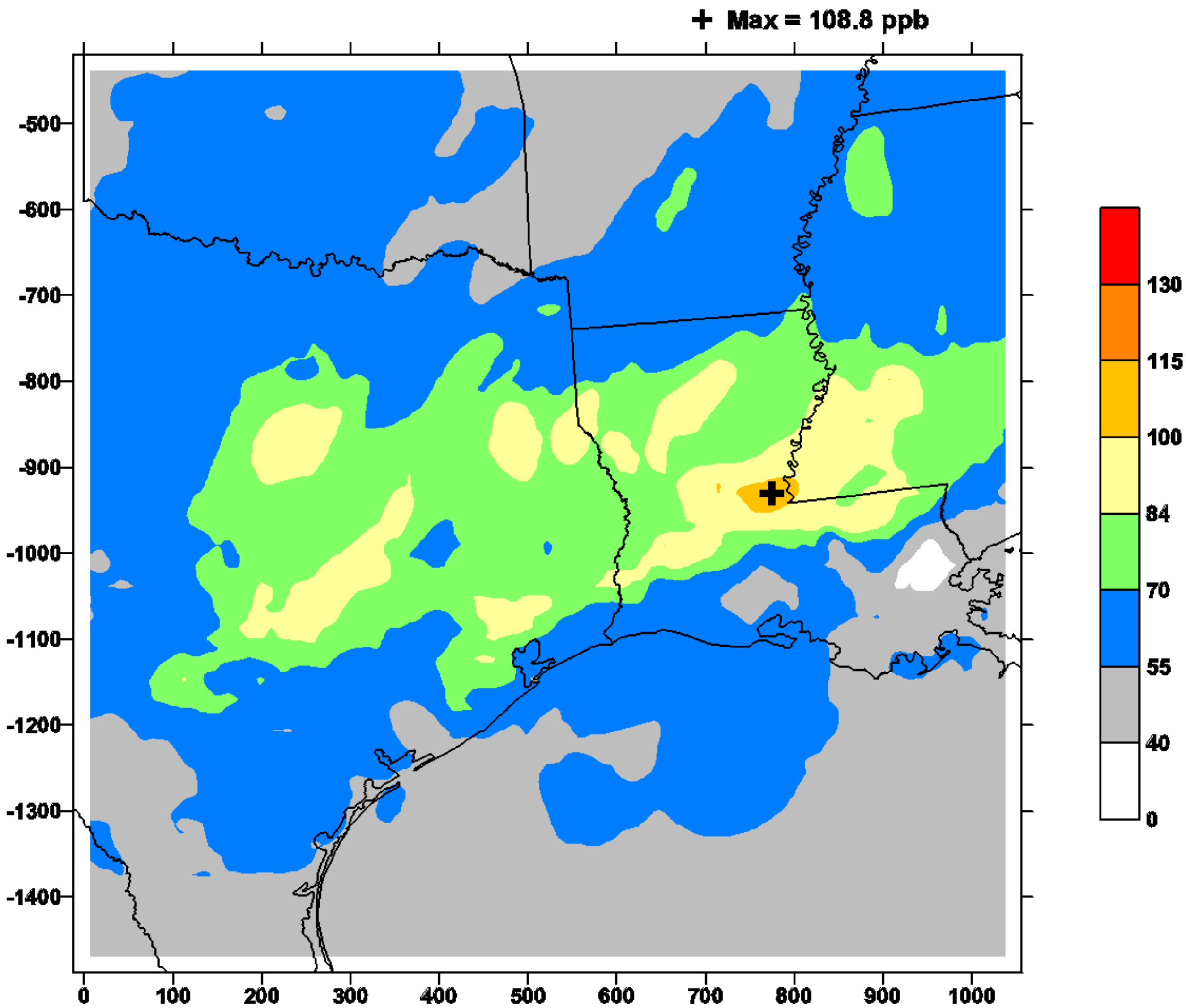
Daily Max 8-Hour Ozone(ppb)
1999 base7
August 17, 1999



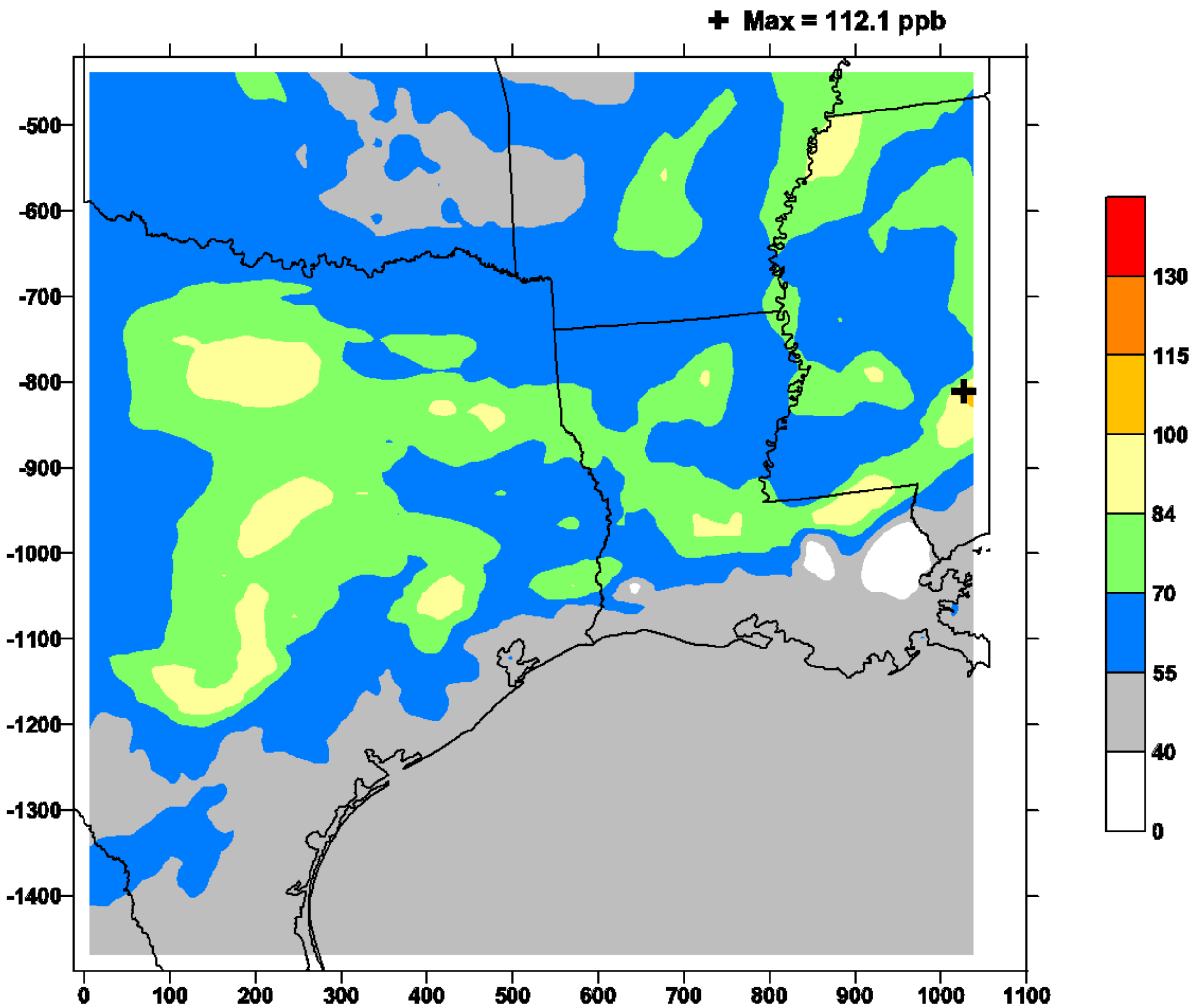
Daily Max 8-Hour Ozone(ppb)
1999 base7
August 18, 1999



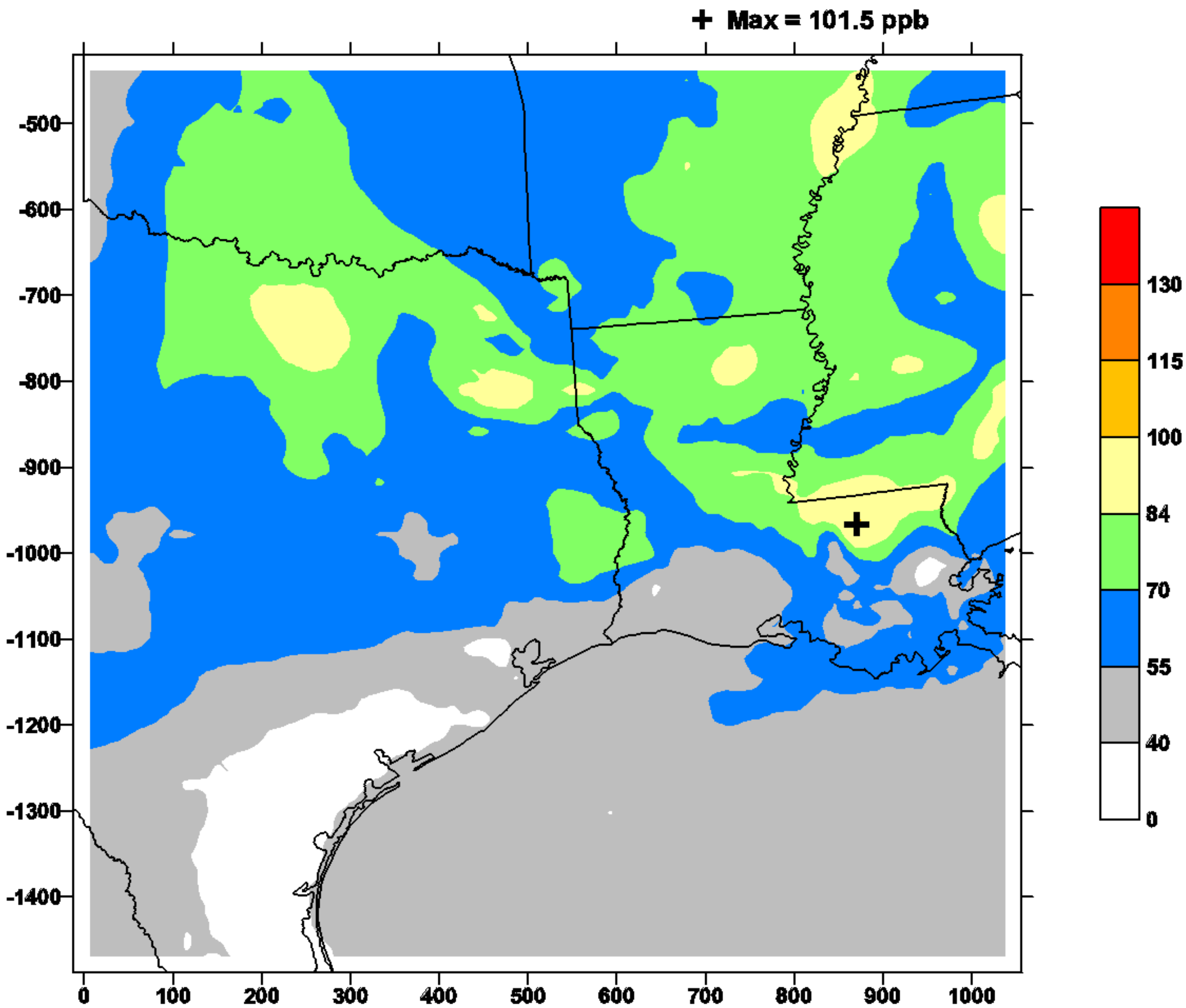
Daily Max 8-Hour Ozone(ppb)
1999 base7
August 19, 1999



Daily Max 8-Hour Ozone(ppb)
1999 base7
August 20, 1999



Daily Max 8-Hour Ozone(ppb)
1999 base7
August 21, 1999

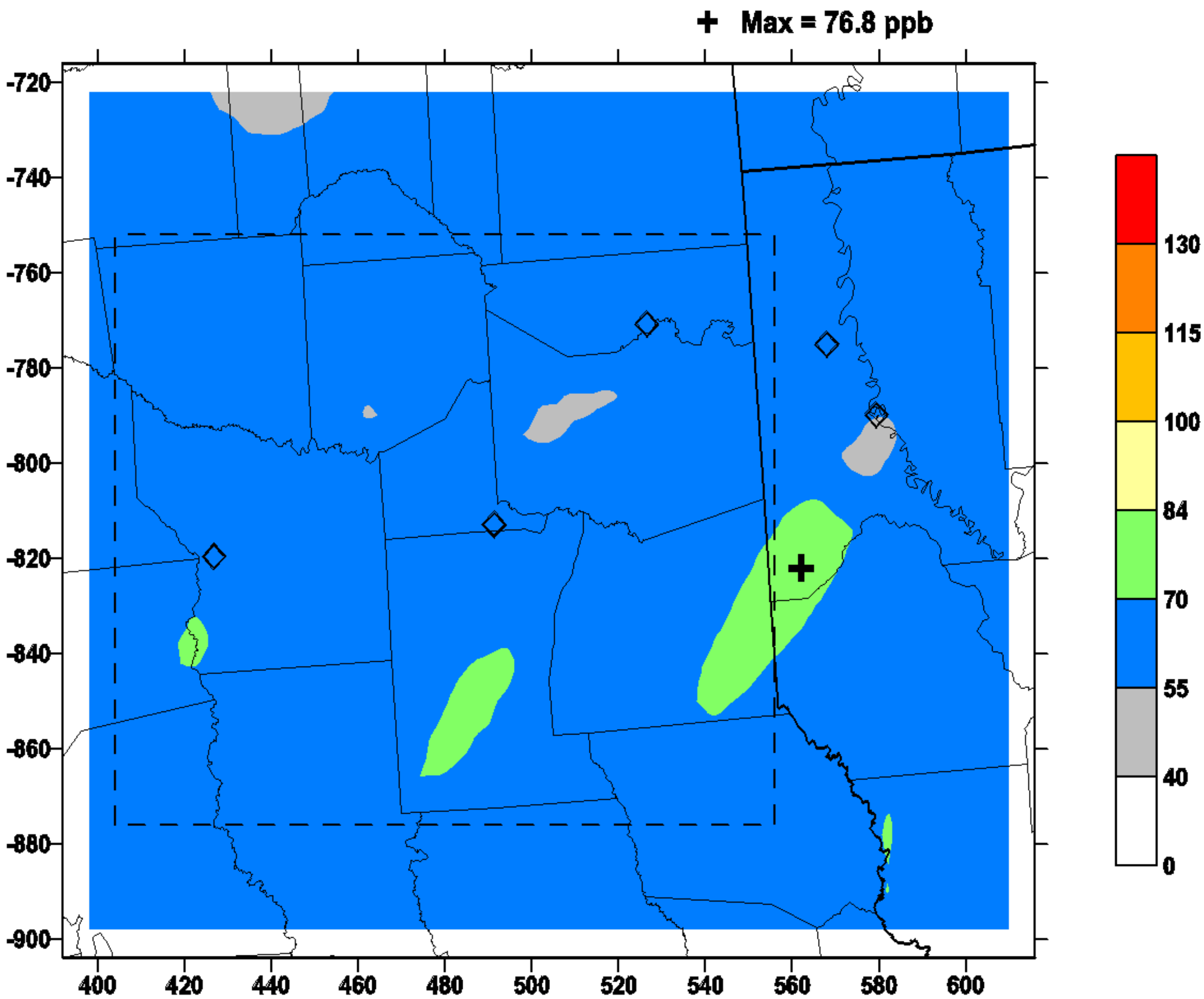


Daily Max 8-Hour Ozone(ppb)
1999 base7
August 22, 1999

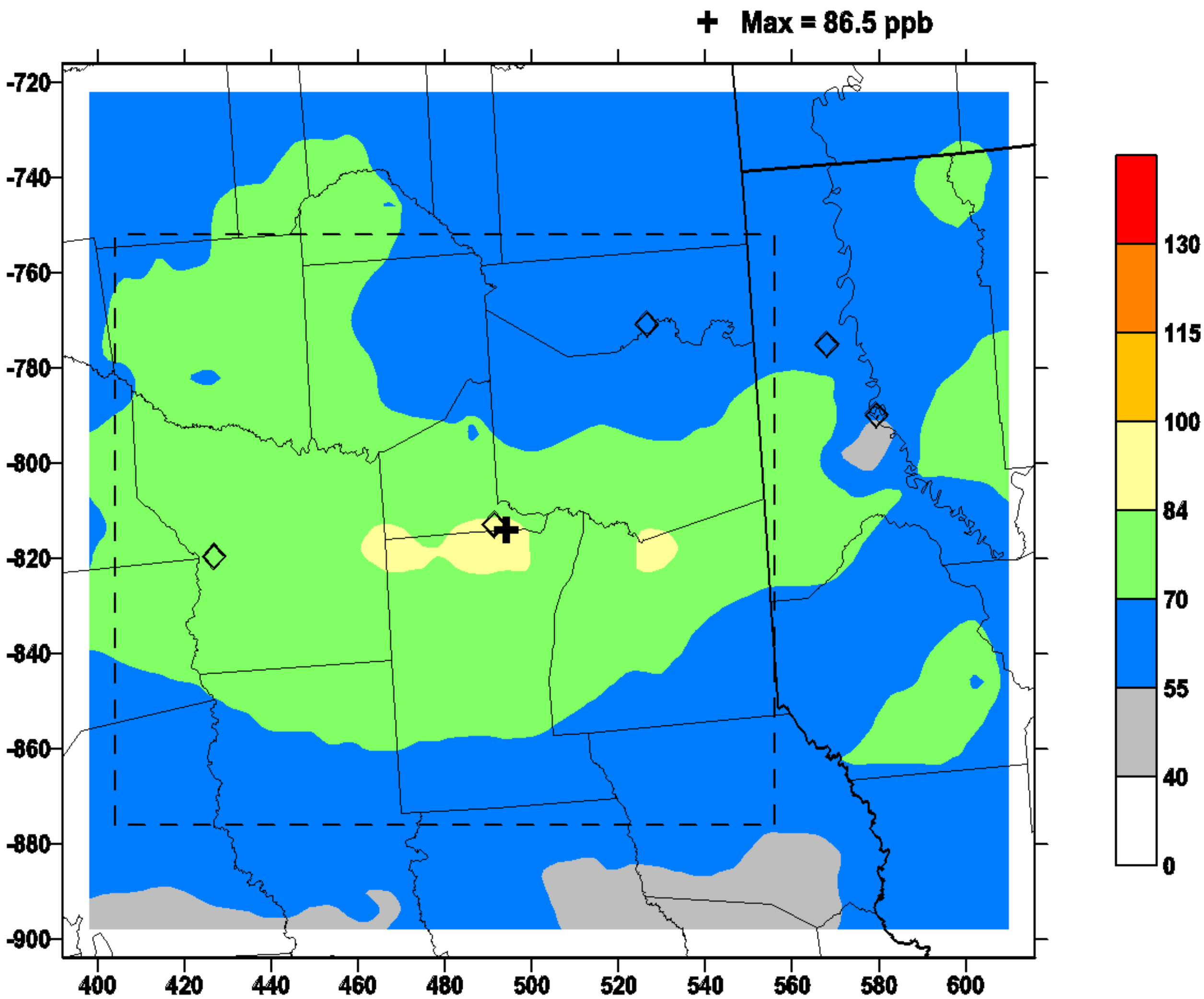
Appendix C

Spatial Maps of Estimated
Daily Maximum 8-Hour Ozone (ppb)
in the 4-km Grid
for the August 15–22, 1999 Episode:

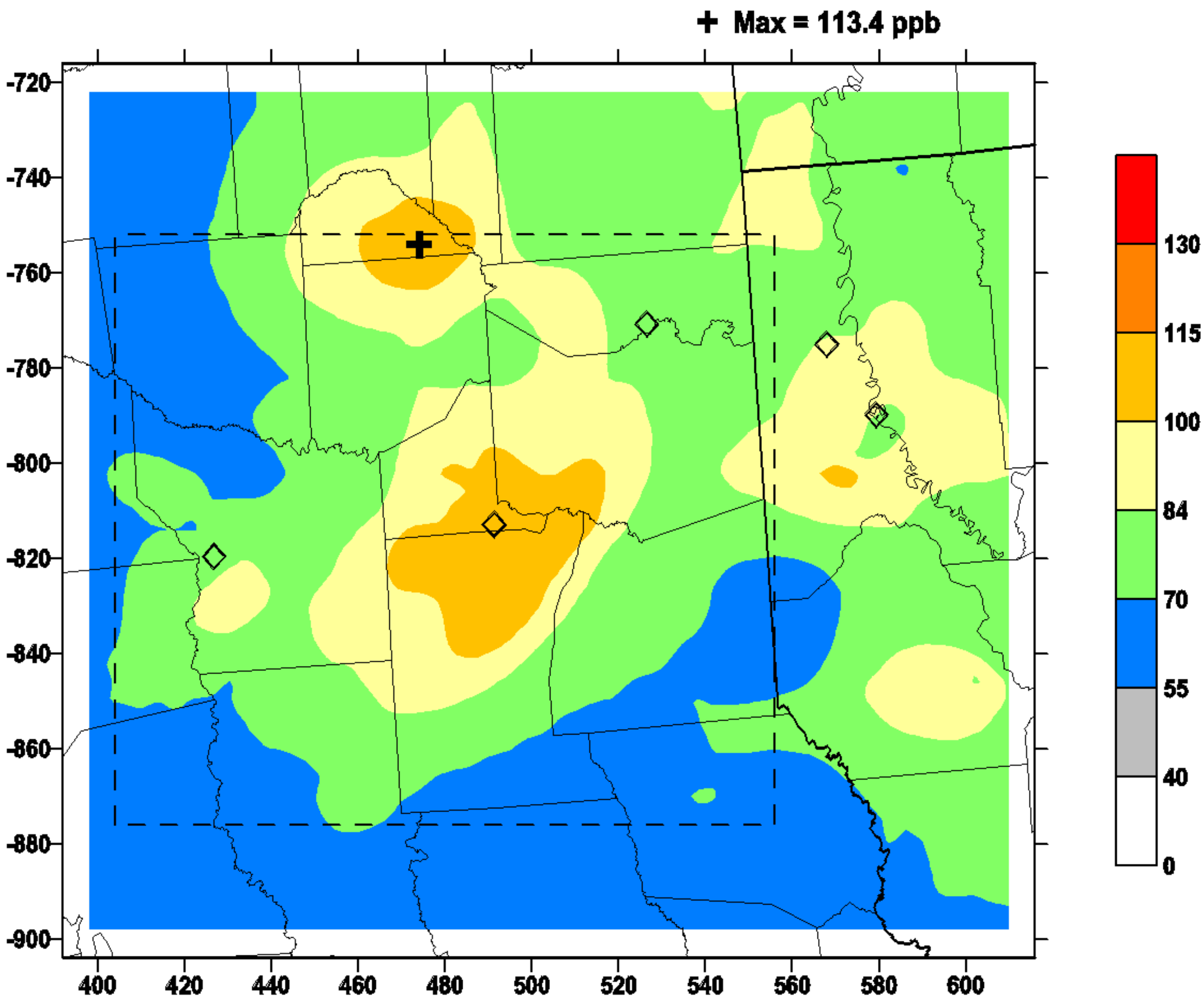
2002 Base Case 3



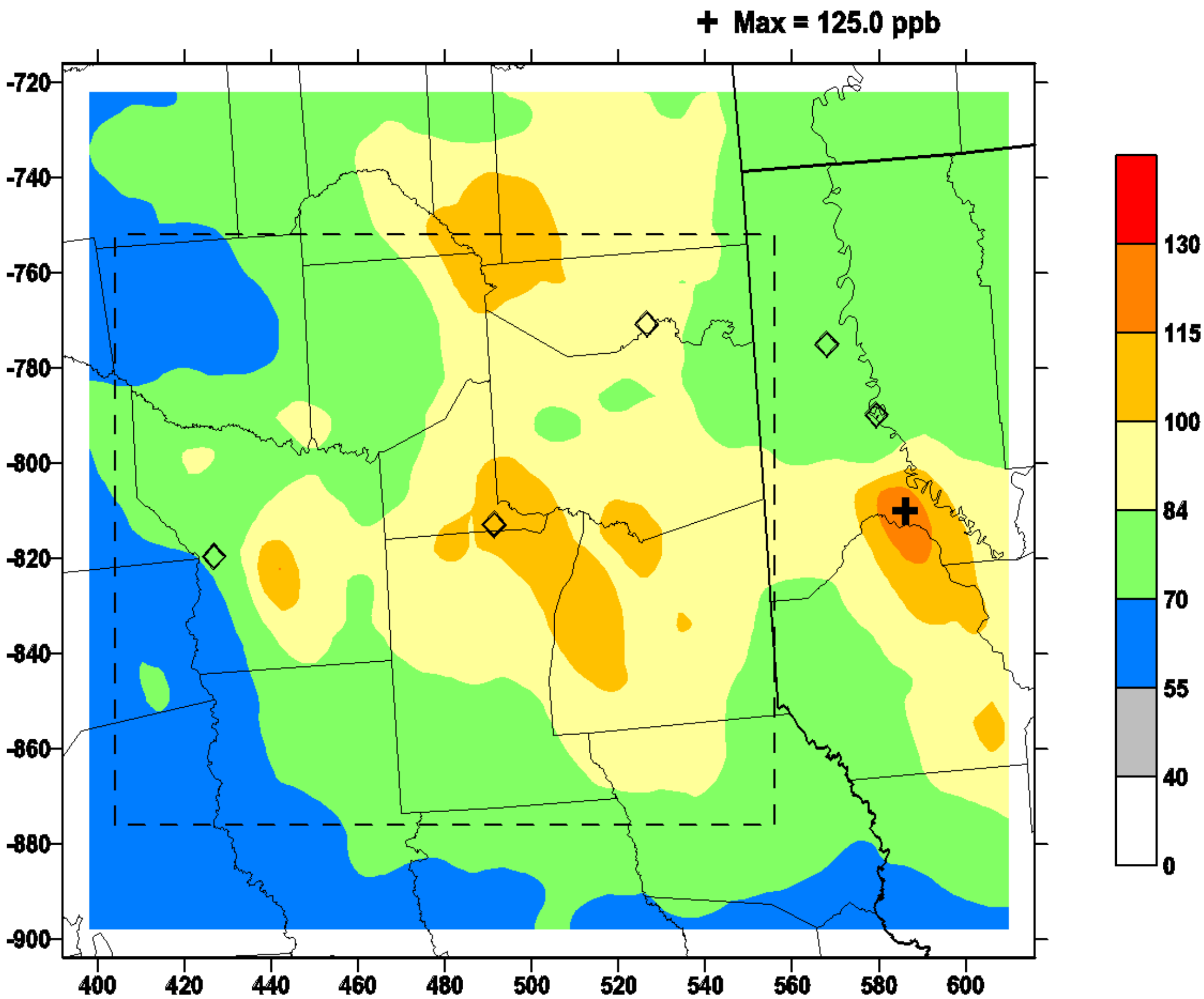
Daily Max 8-Hour Ozone(ppb)
2002 base3
August 15, 1999



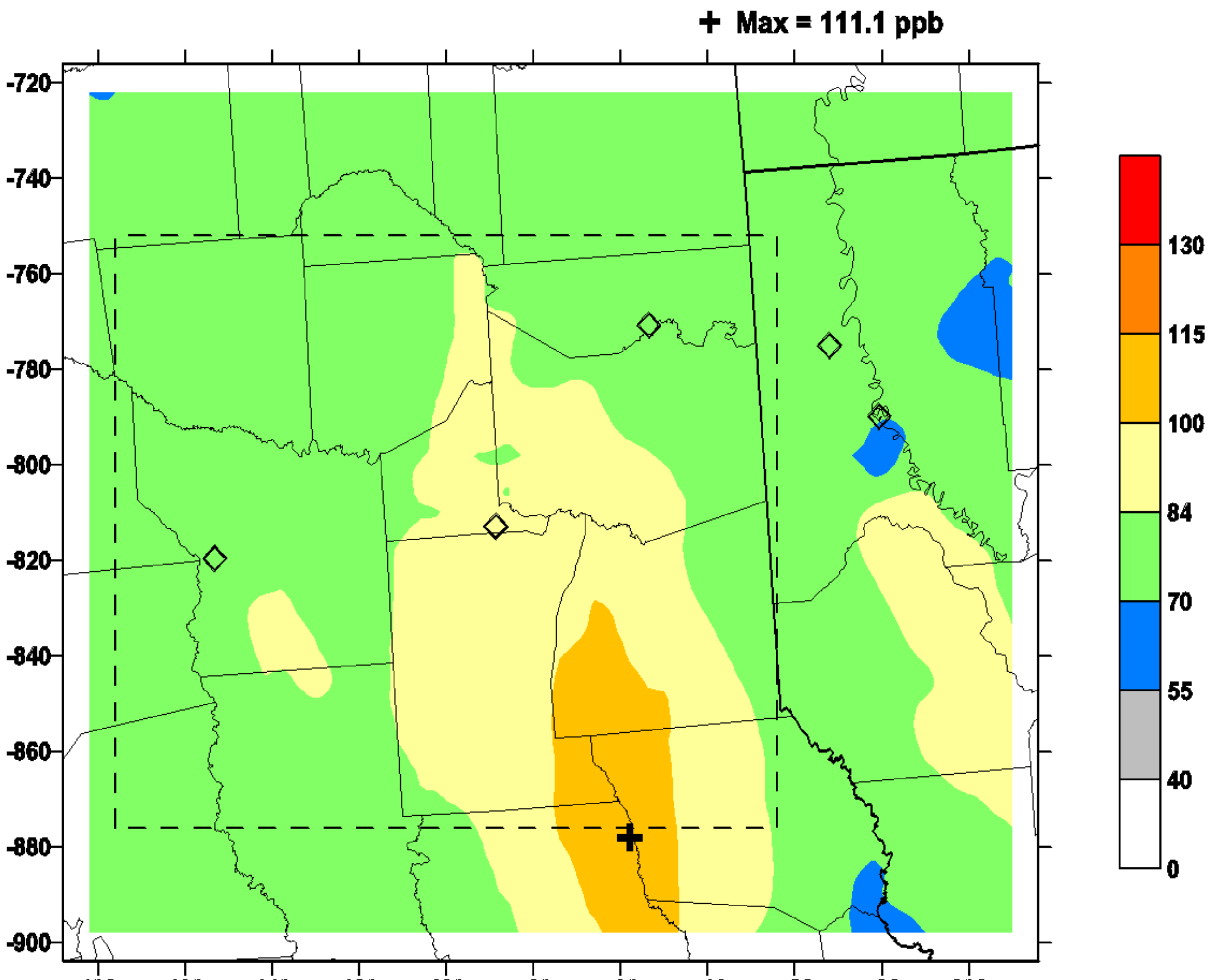
Daily Max 8-Hour Ozone(ppb)
2002 base3
August 16, 1999



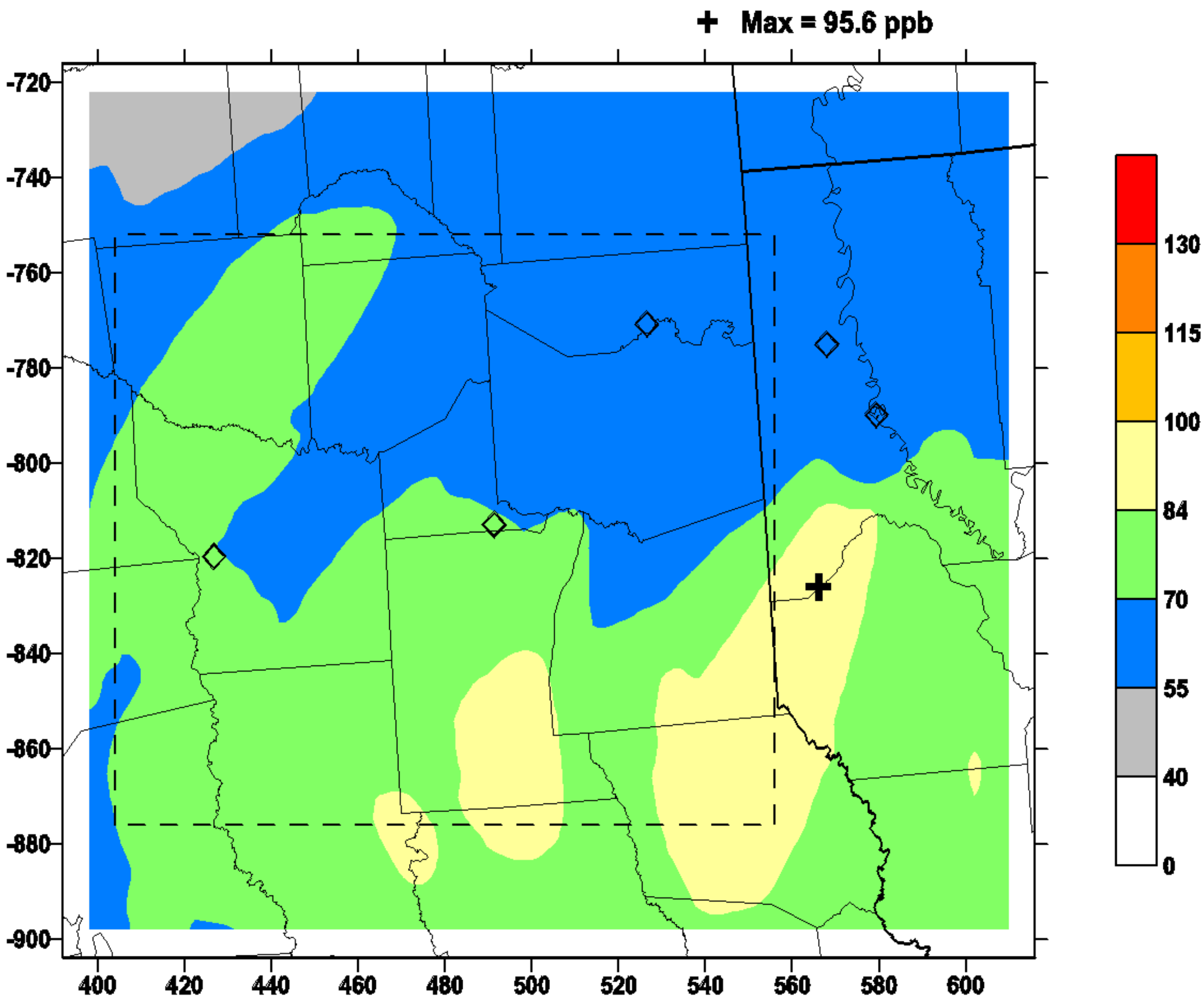
Daily Max 8-Hour Ozone(ppb)
2002 base3
August 17, 1999



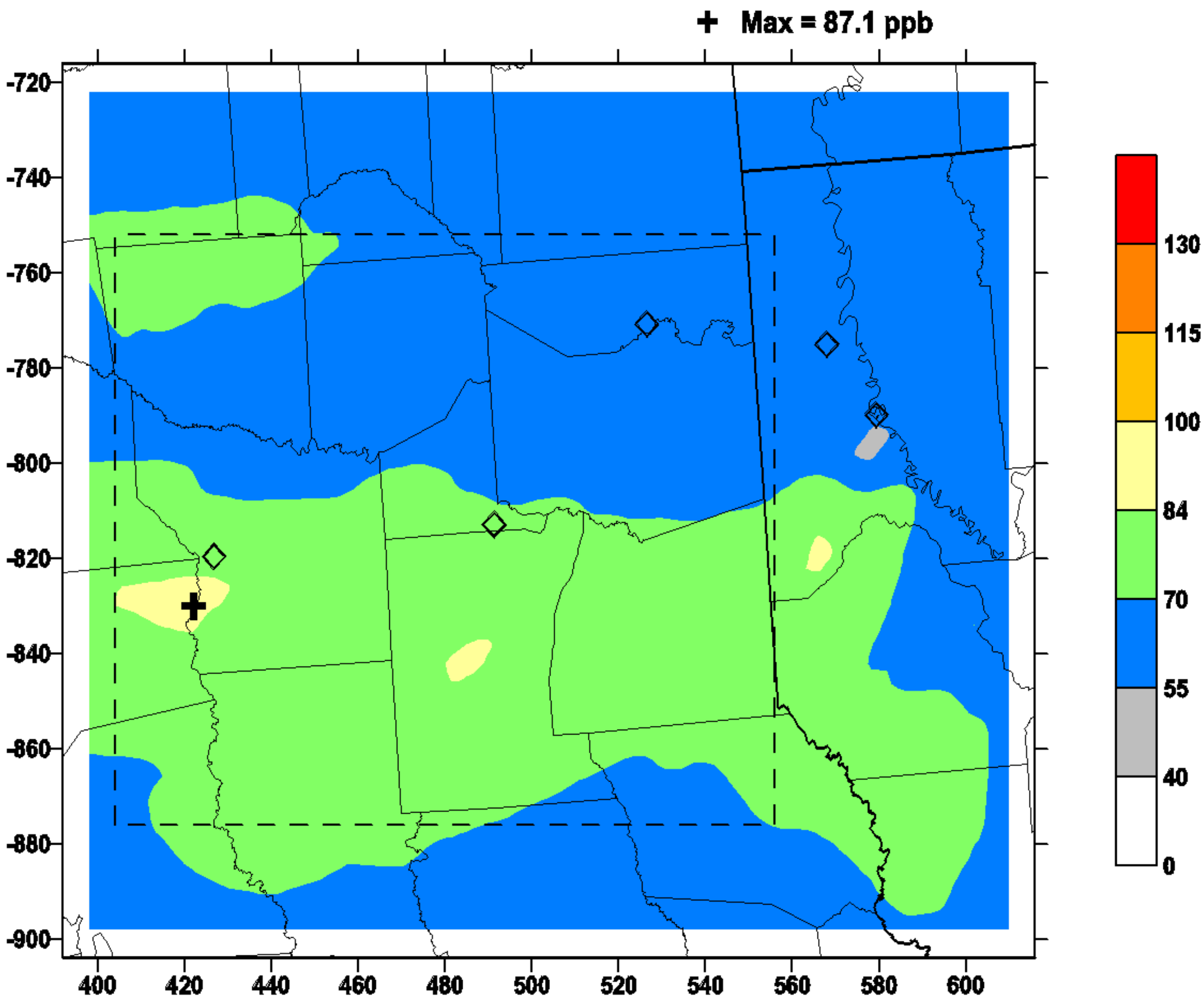
Daily Max 8-Hour Ozone(ppb)
2002 base3
August 18, 1999



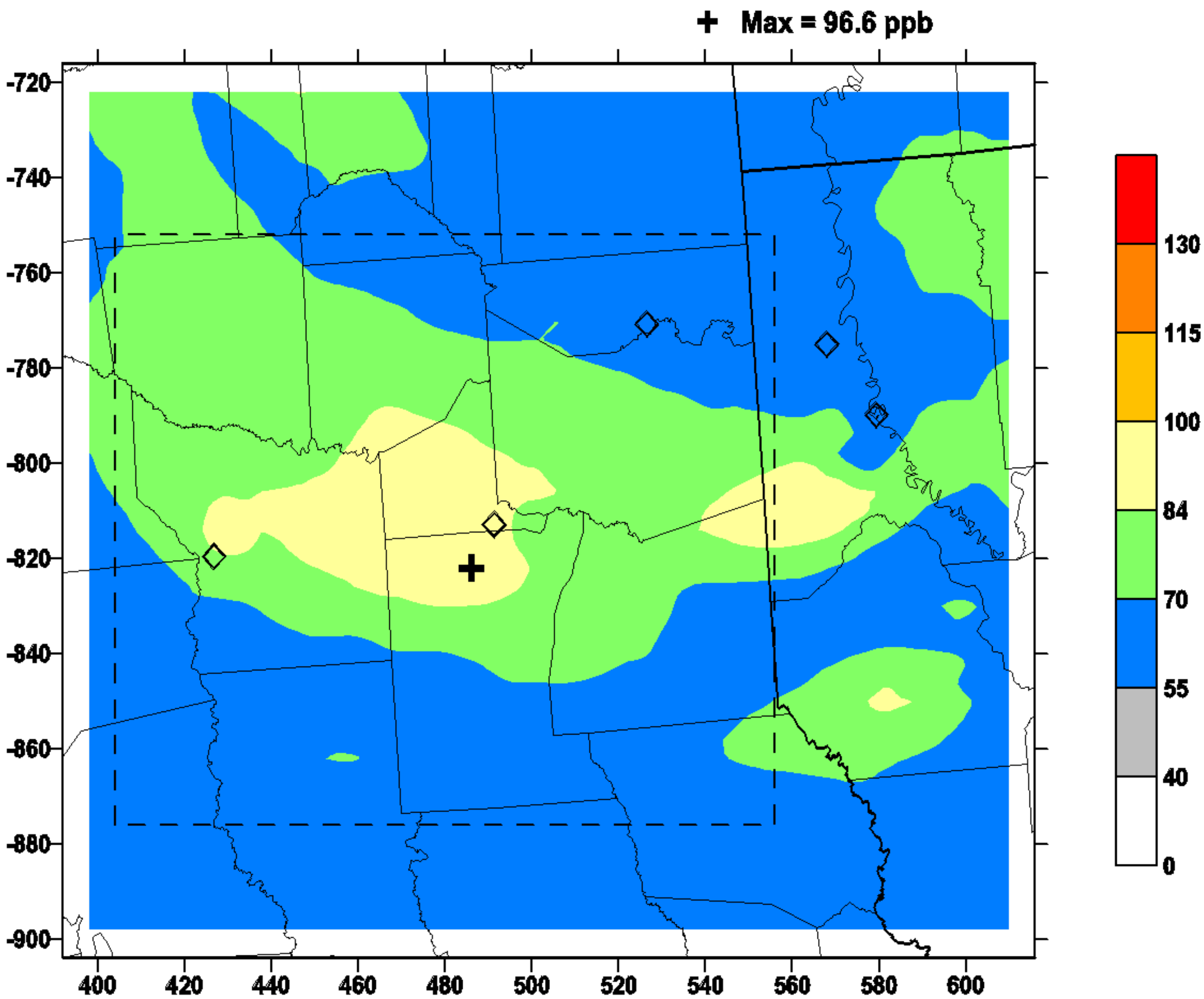
Daily Max 8-Hour Ozone(ppb)
2002 base3
August 19, 1999



Daily Max 8-Hour Ozone(ppb)
2002 base3
August 20, 1999



Daily Max 8-Hour Ozone(ppb)
2002 base3
August 21, 1999

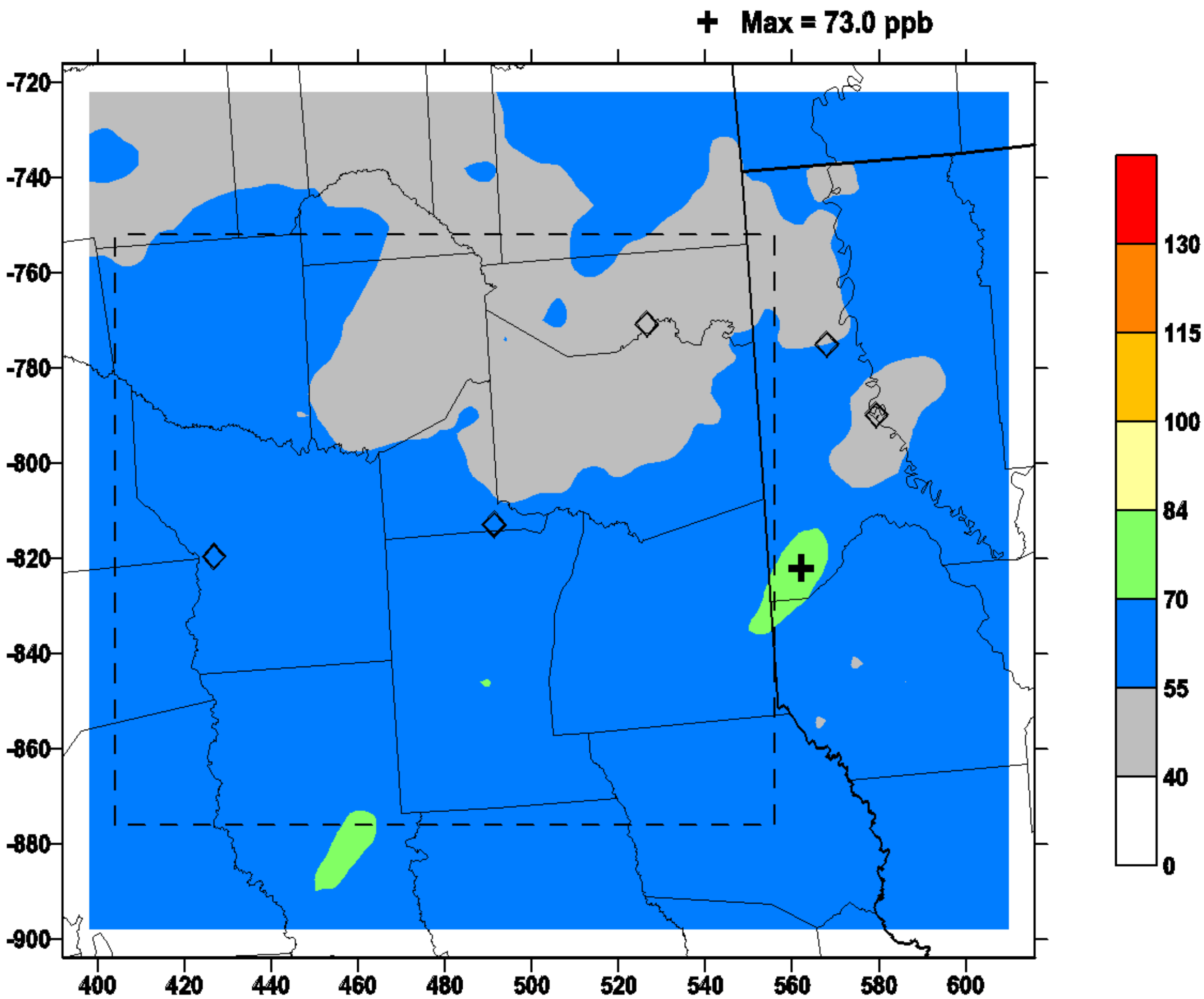


Daily Max 8-Hour Ozone(ppb)
2002 base3
August 22, 1999

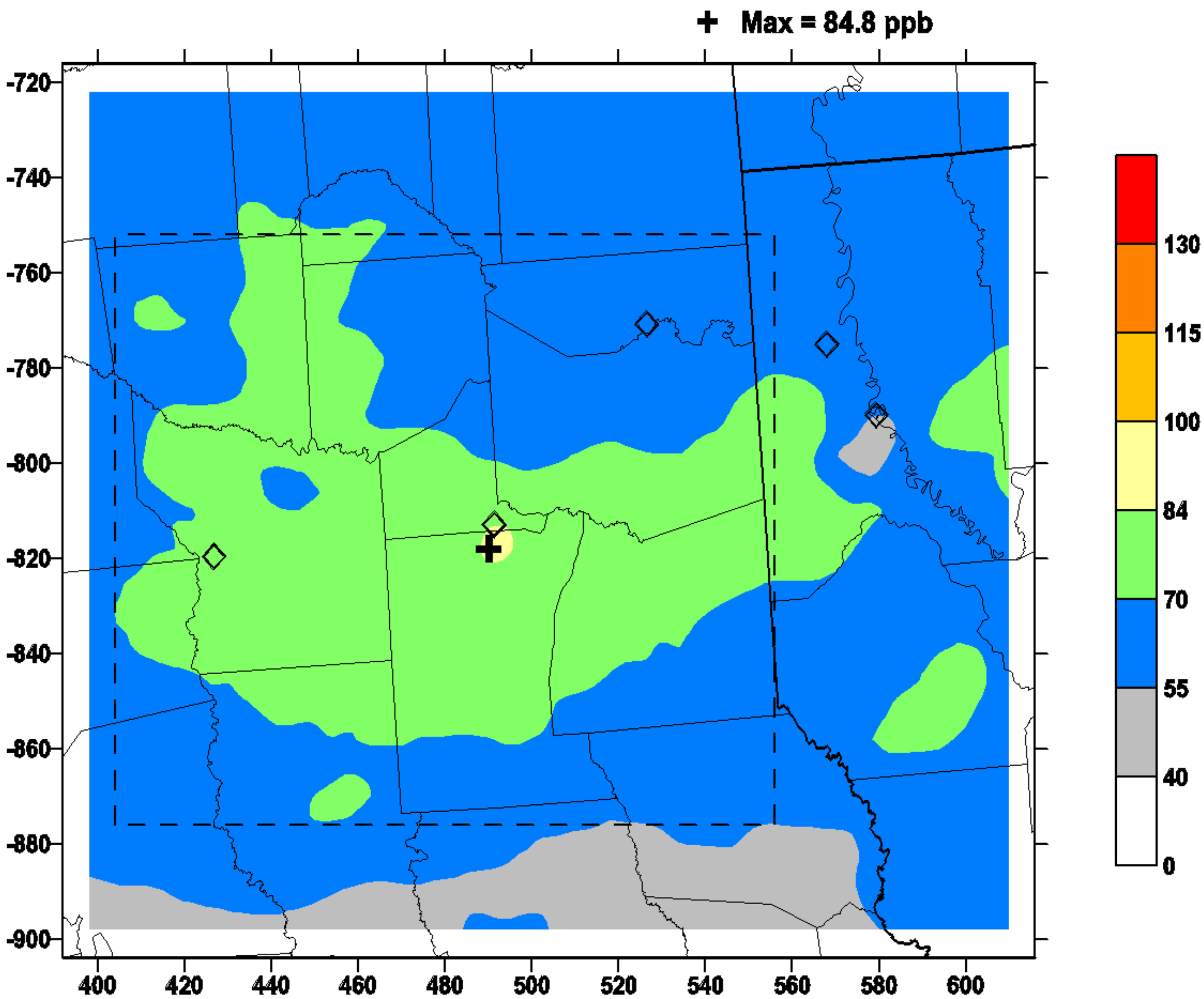
Appendix D

Spatial Maps of Estimated
Daily Maximum 8-Hour Ozone (ppb)
In the 4-km Grid
For the August 15–22, 1999 Episode:

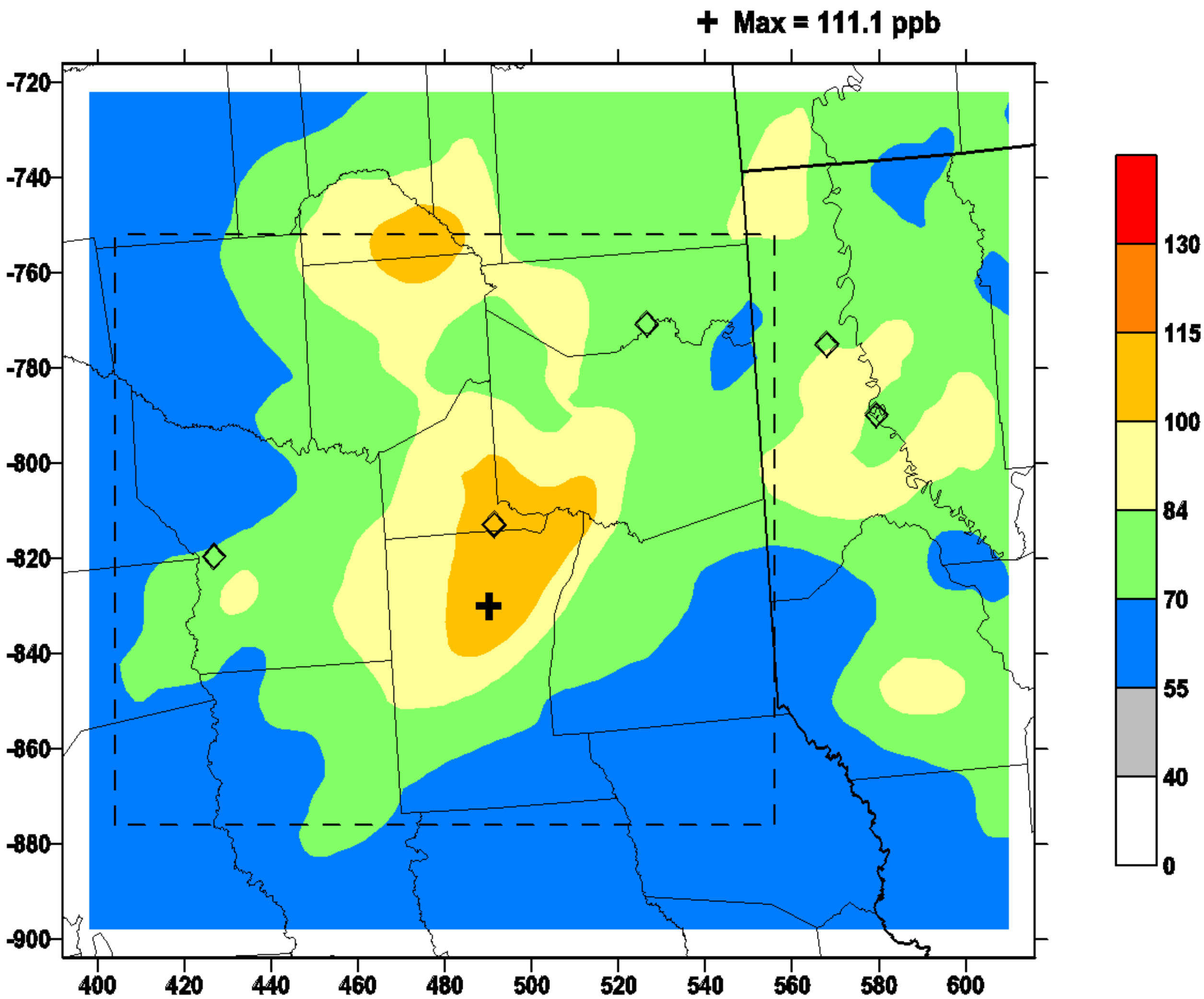
2007 Base Case 5



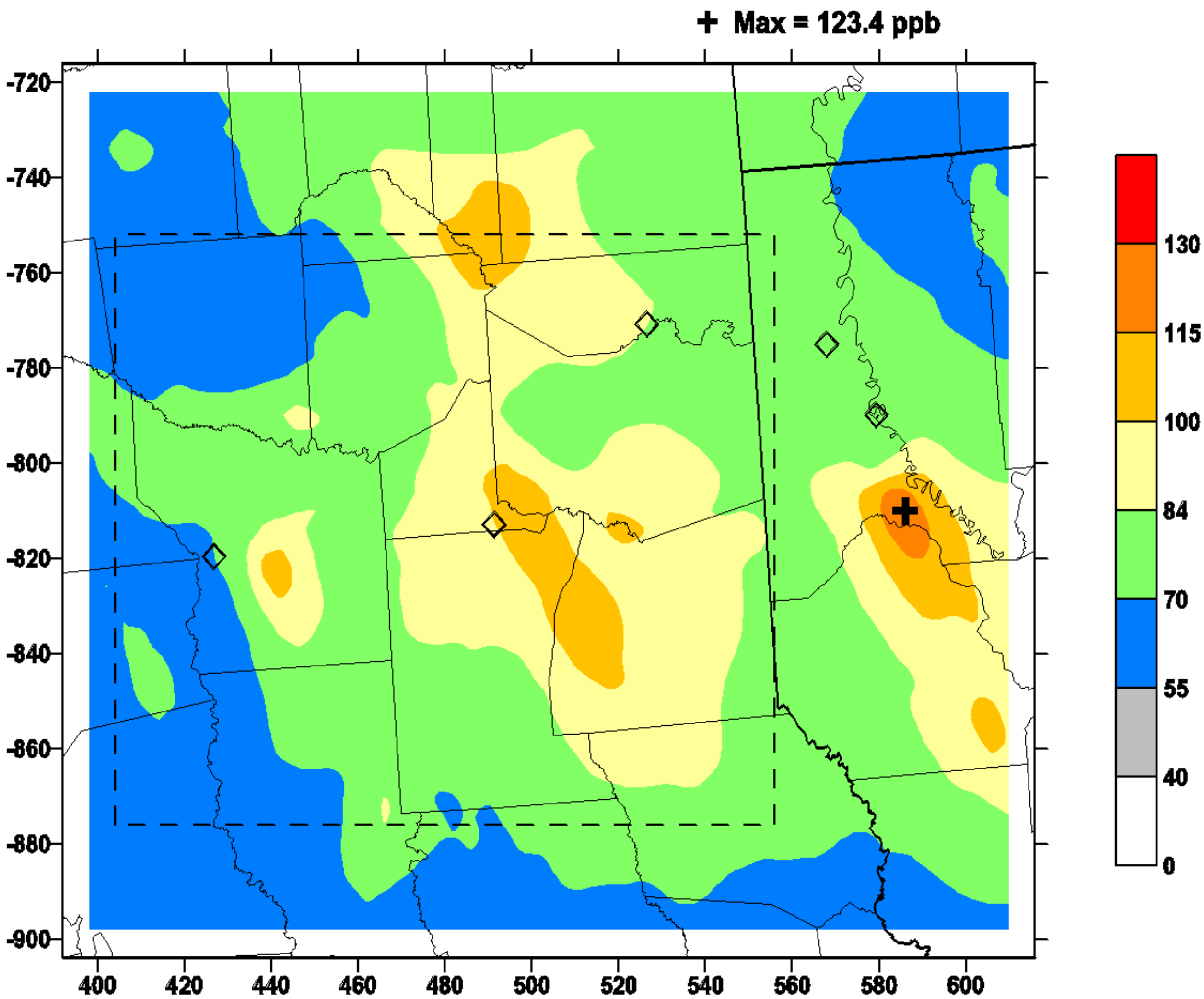
Daily Max 8-Hour Ozone(ppb)
2007 base5
August 15, 1999



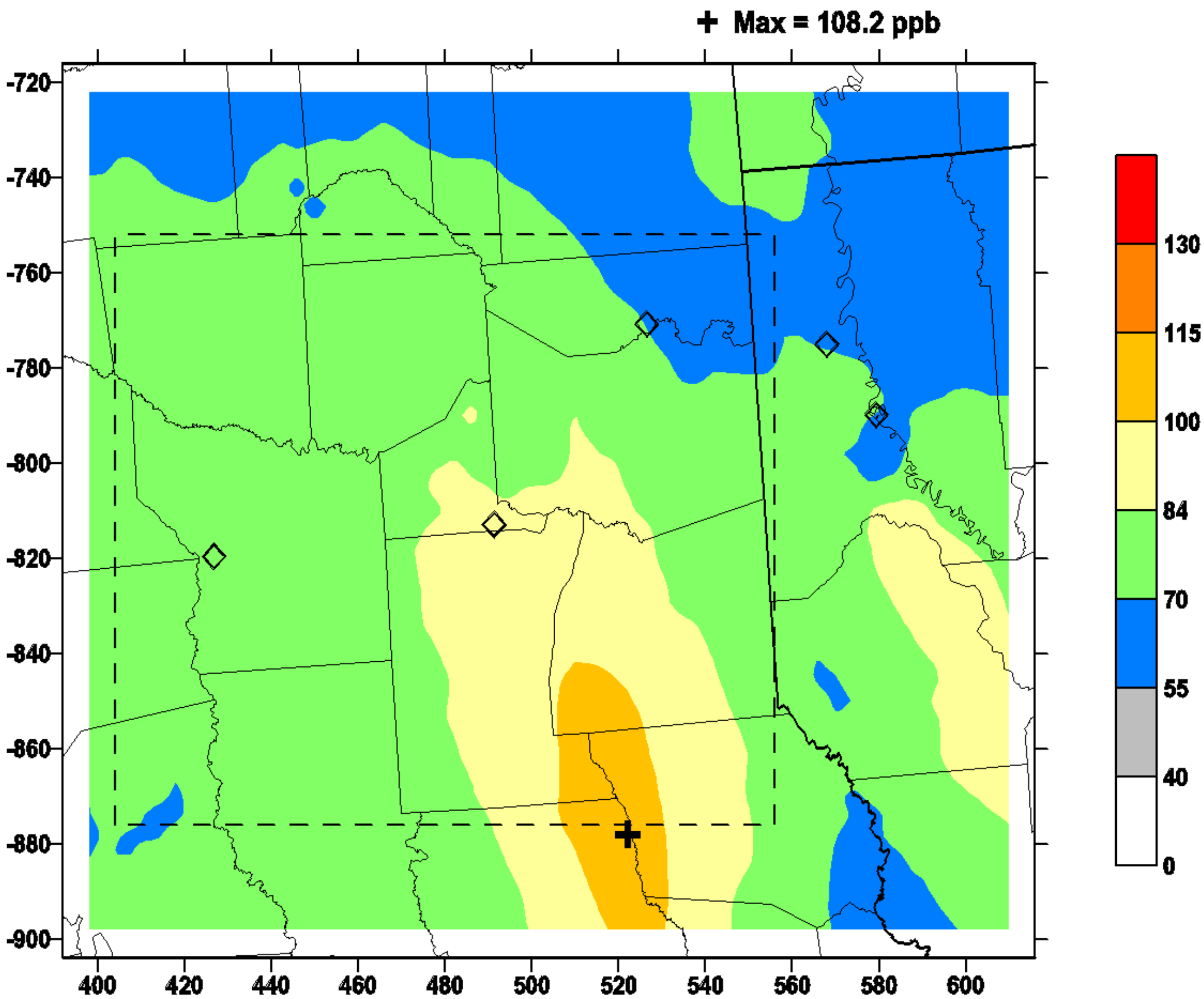
Daily Max 8-Hour Ozone(ppb)
2007 base5
August 16, 1999



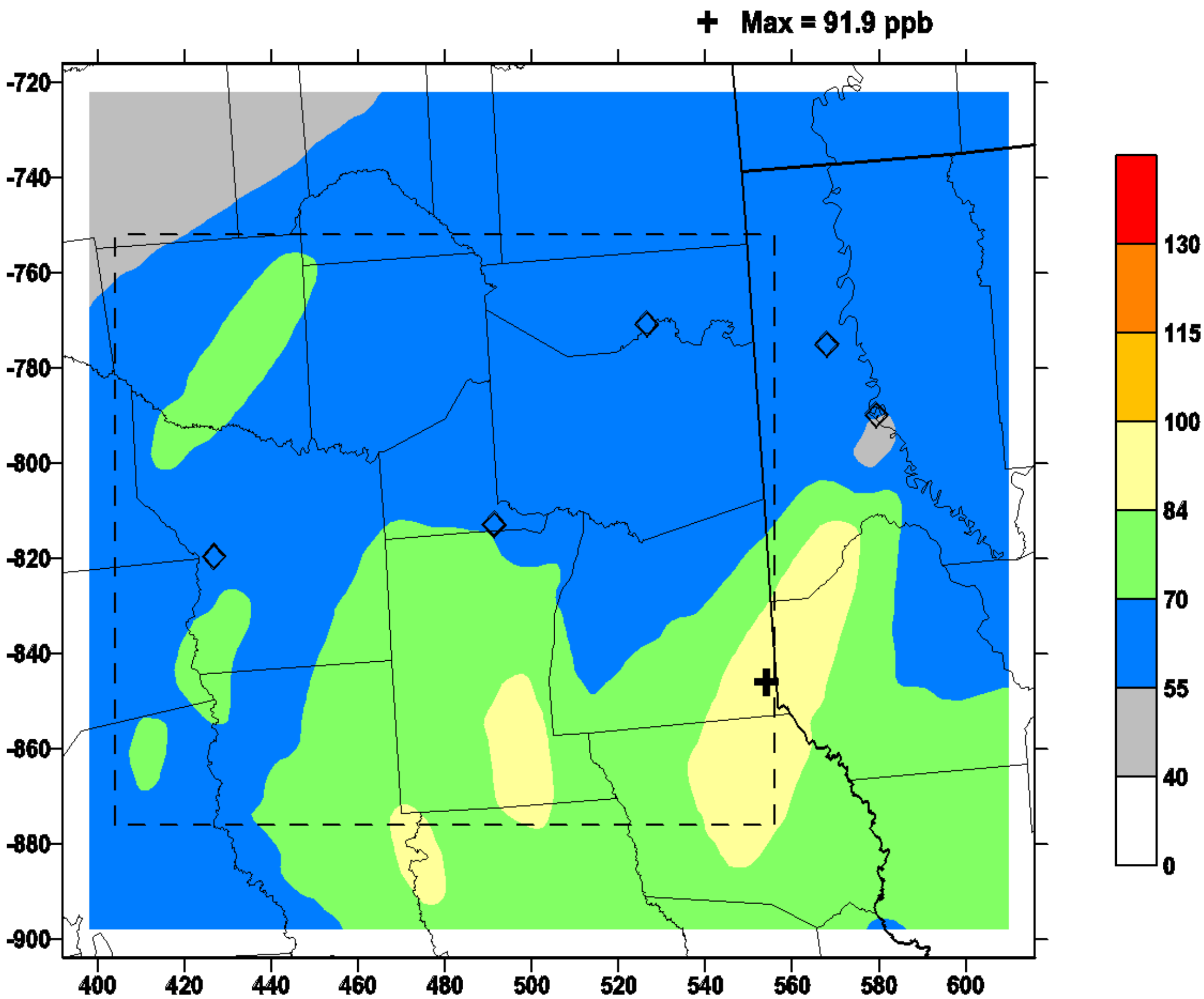
Daily Max 8-Hour Ozone(ppb)
2007 base5
August 17, 1999



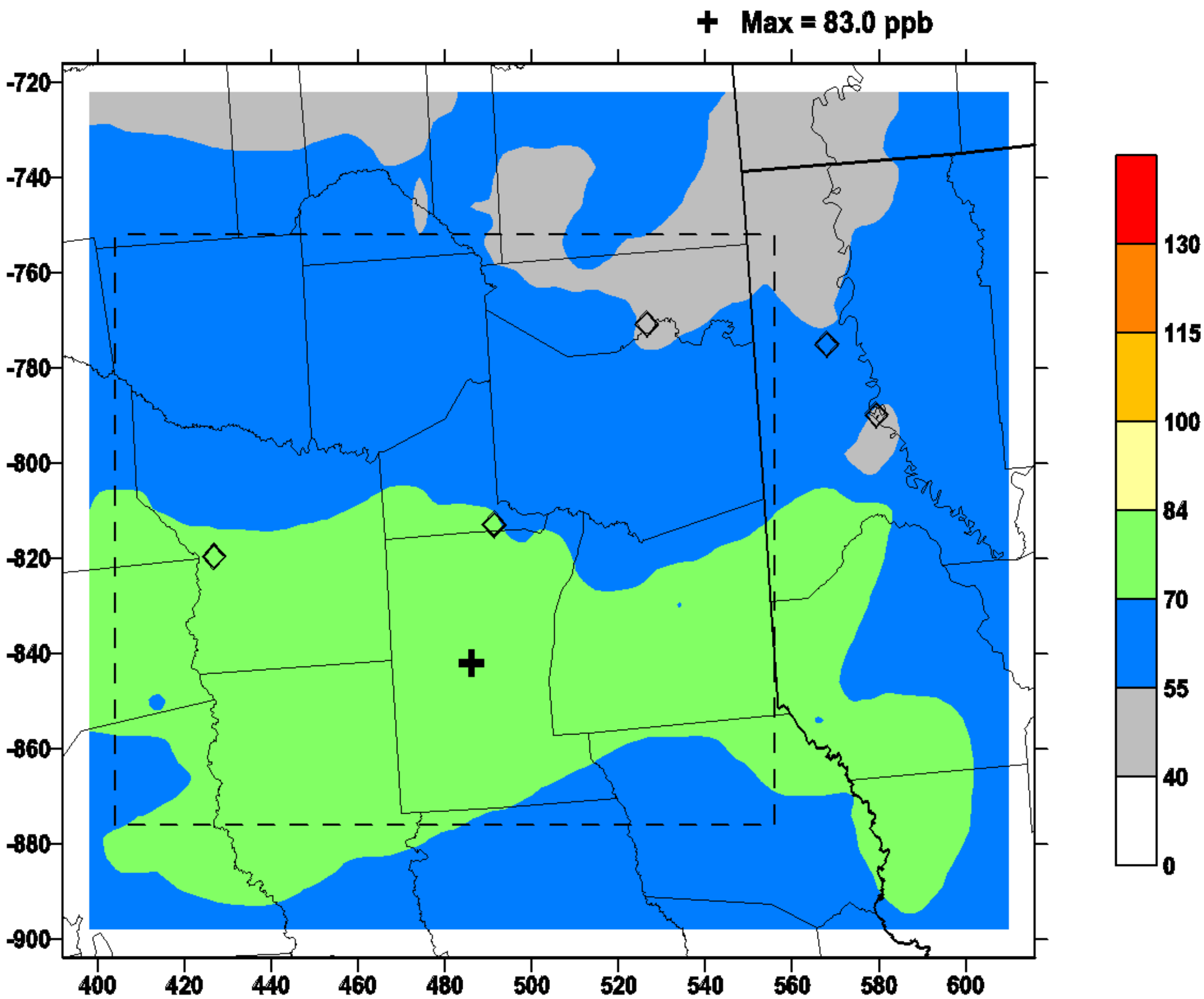
Daily Max 8-Hour Ozone(ppb)
2007 base5
August 18, 1999



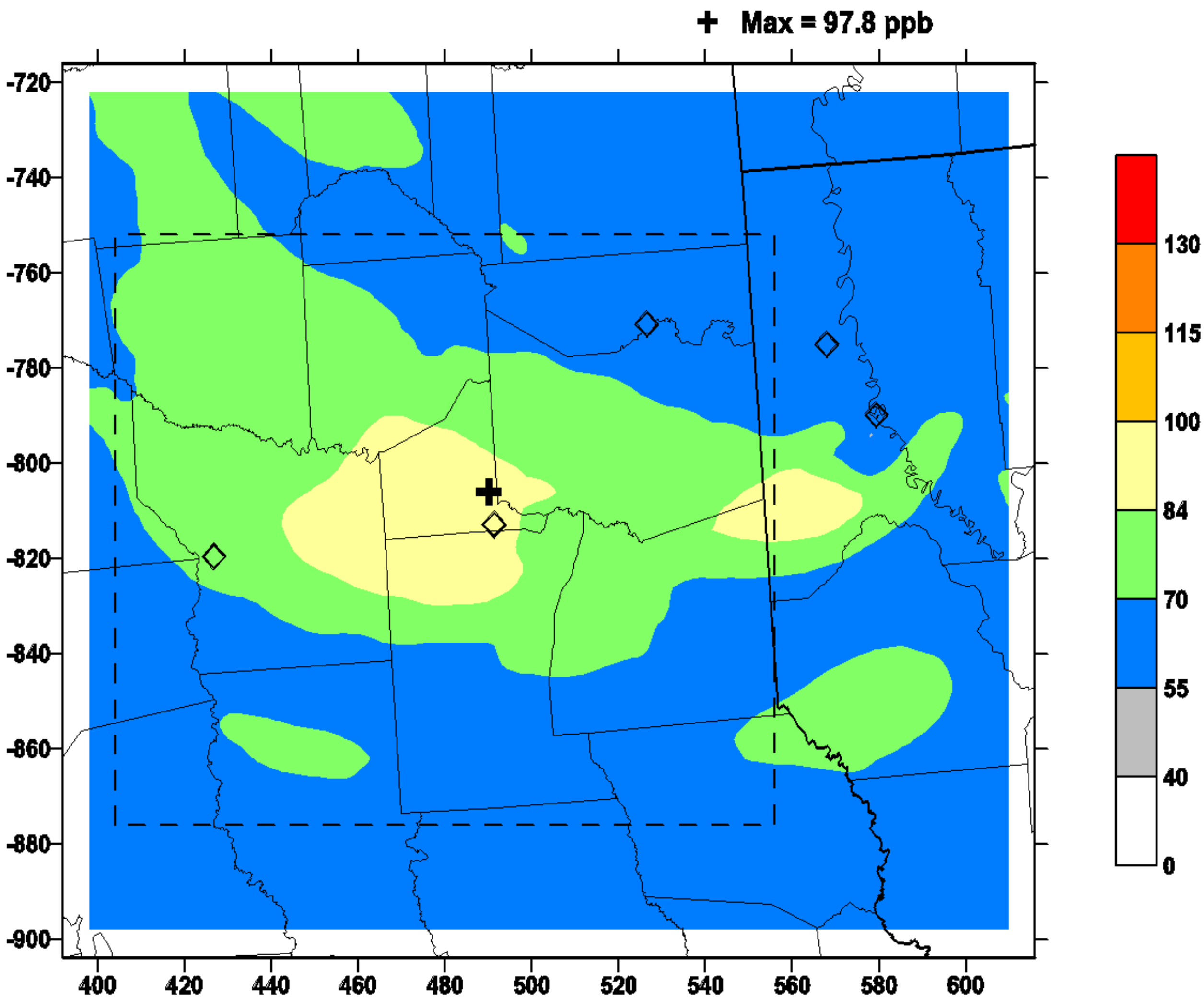
Daily Max 8-Hour Ozone(ppb)
2007 base5
August 19, 1999



Daily Max 8-Hour Ozone(ppb)
2007 base5
August 20, 1999



Daily Max 8-Hour Ozone(ppb)
2007 base5
August 21, 1999



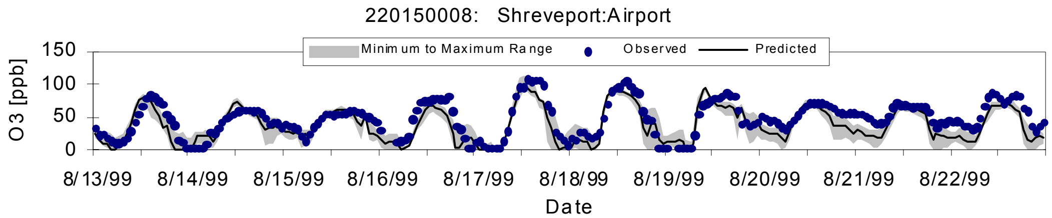
Daily Max 8-Hour Ozone(ppb)
2007 base5
August 22, 1999

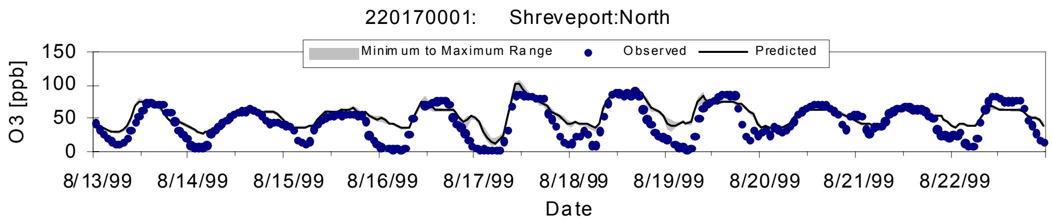
Appendix E

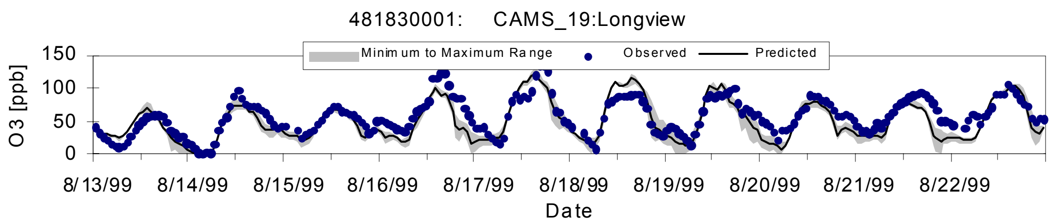
Time Series of Estimated and Observed
1-Hour and 8-Hour Ozone (ppb)
for AIRS Monitors in the 4-km Grid
for the August 15-22, 1999 Episode:

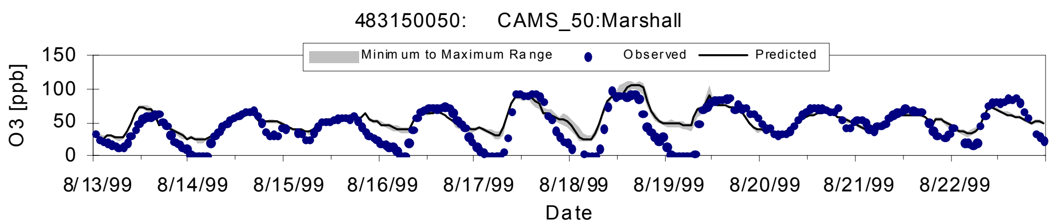
1999 Base Case 7

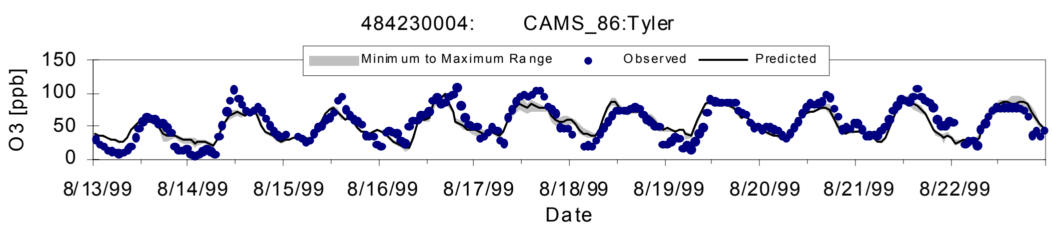
ETCOG 4-km Grid: Base Case 7 1-Hour Ozone



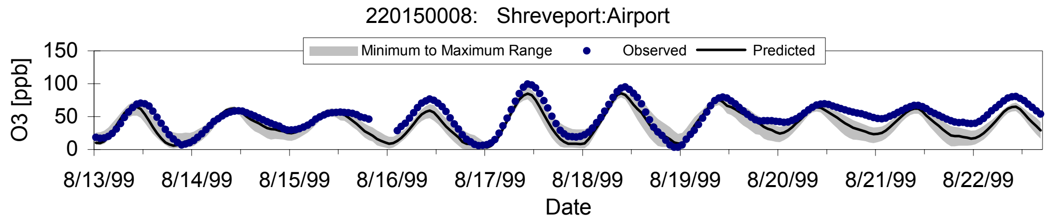


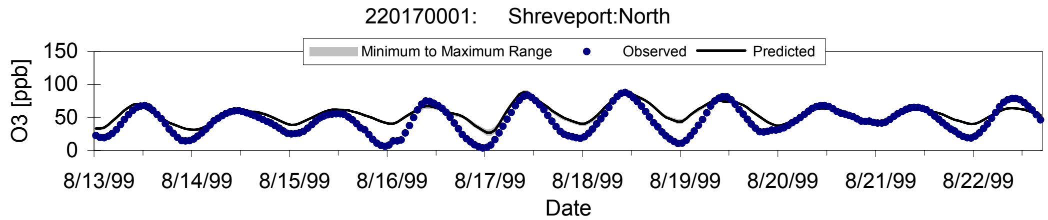


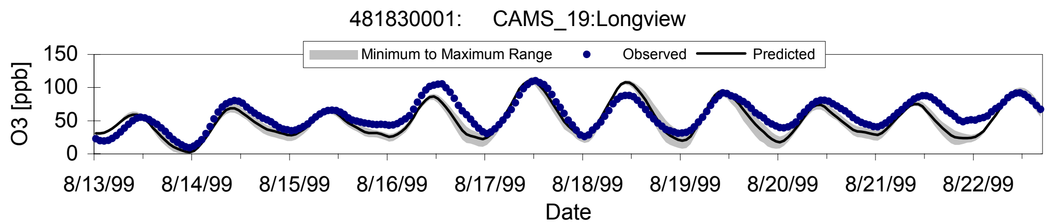


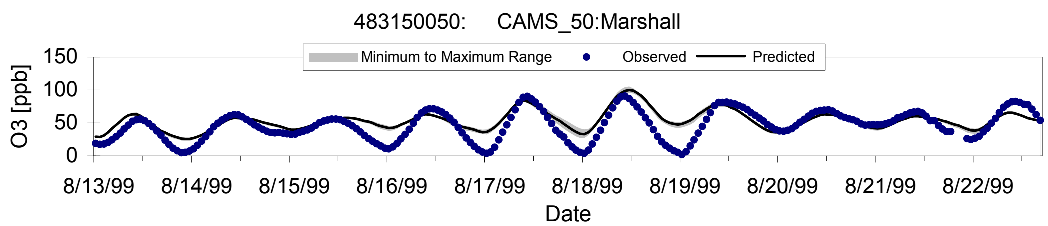


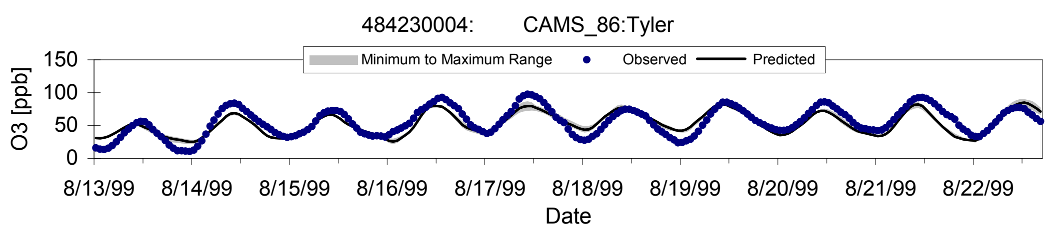
ETCOG 4-km Grid: Base Case 7 8-Hour Ozone











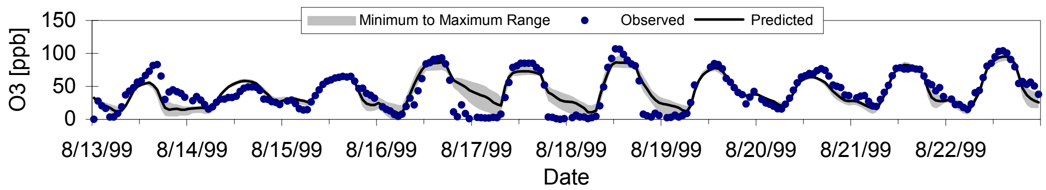
Appendix F

Time Series of Estimated and Observed
1-Hour Ozone (ppb)
for AIRS Monitors in the 12-km Grid
for the August 15-22, 1999 Episode:

1999 Base Case 7

ETCOG 12-km Grid: Base Case 7

50350005: 50350005



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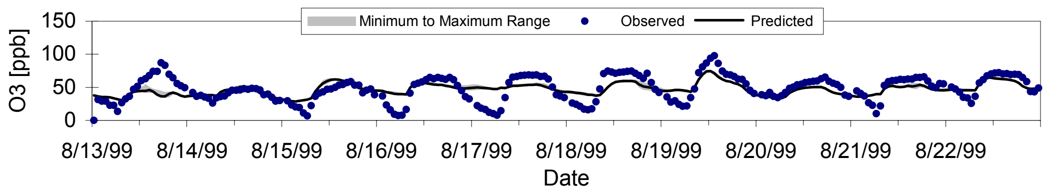

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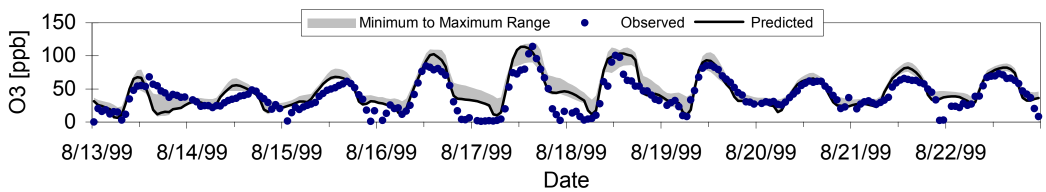

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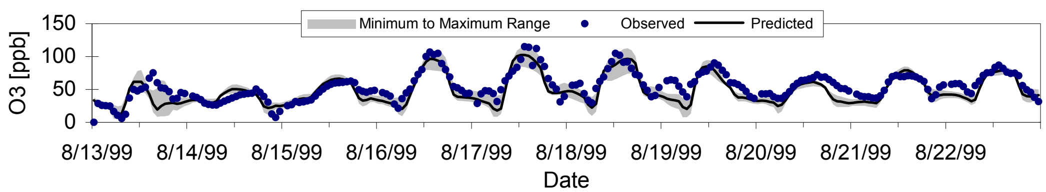

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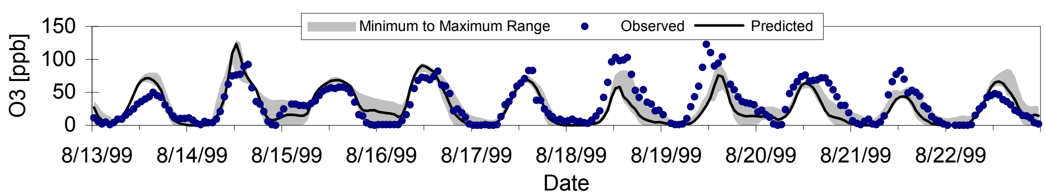

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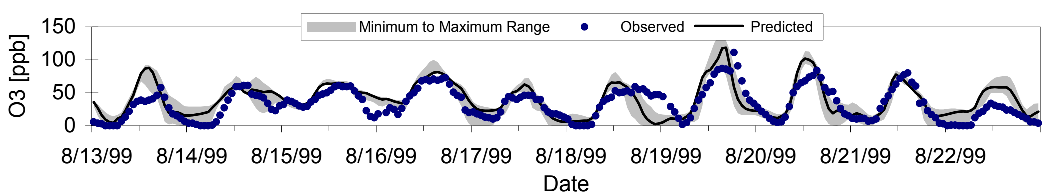
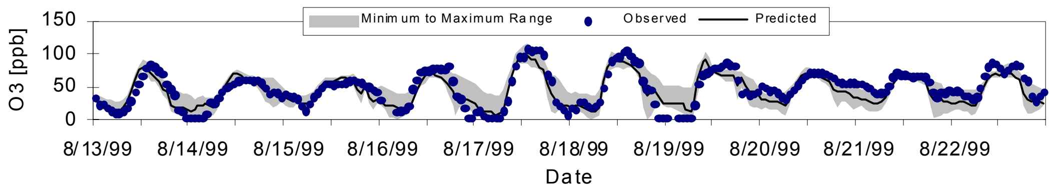


ETCOG 12-km Grid: Base Case 7

220150008: 220150008



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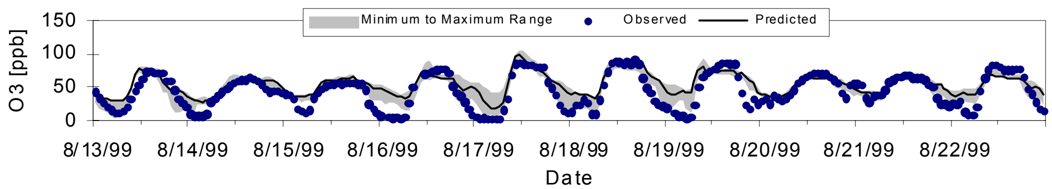

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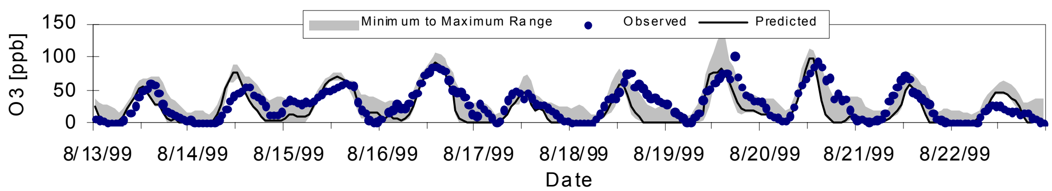

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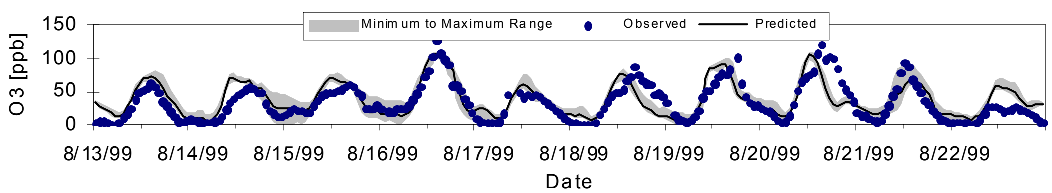

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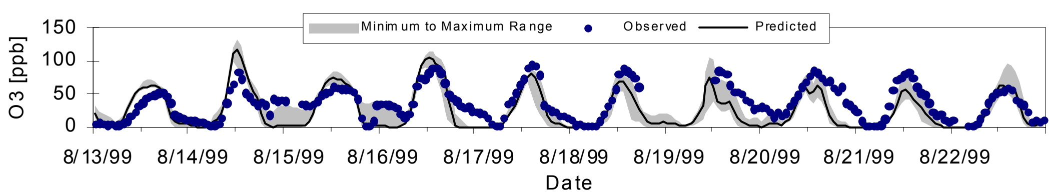

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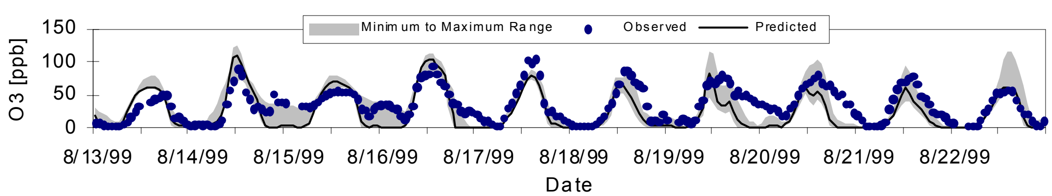

ETCOG 12-km Grid: Base Case 7

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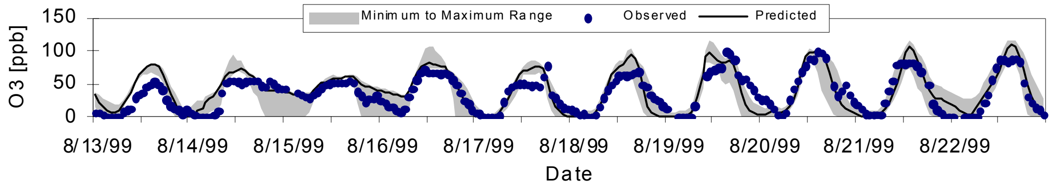

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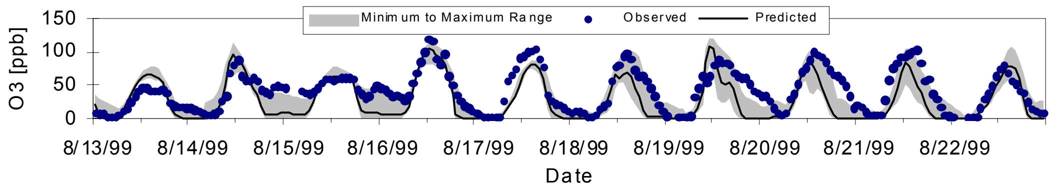

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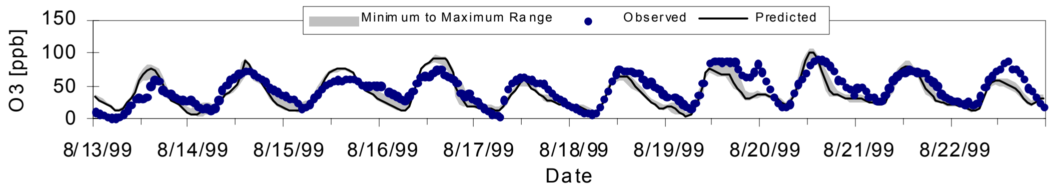

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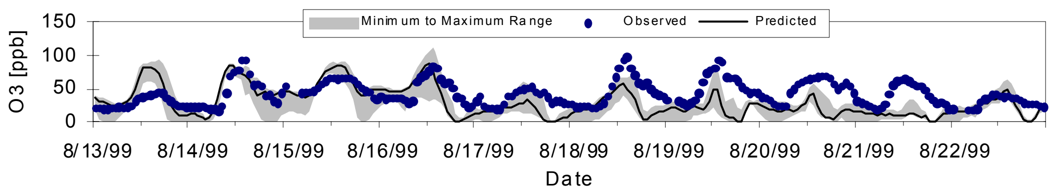

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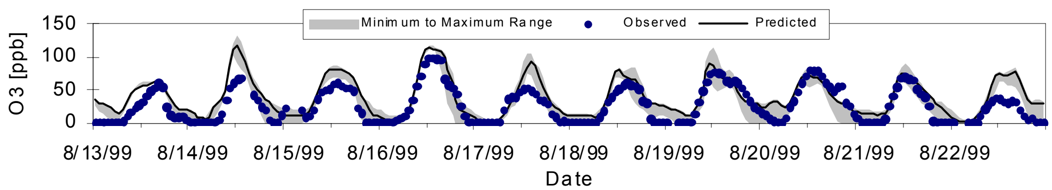

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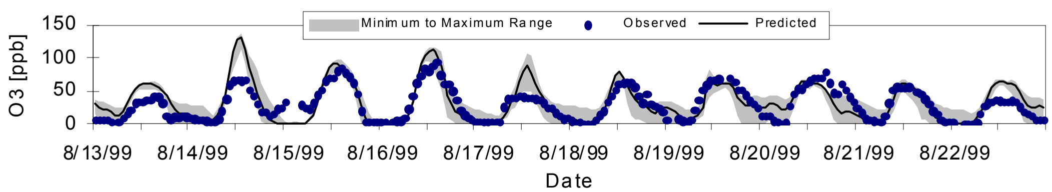
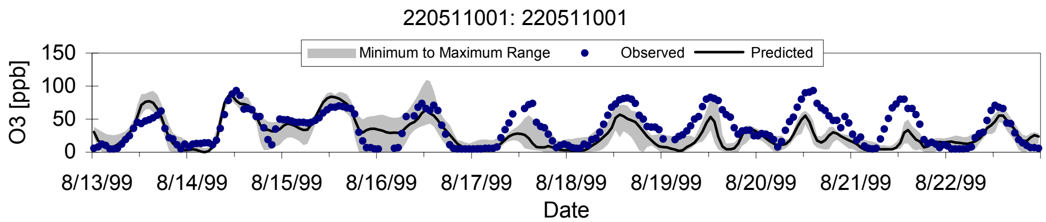
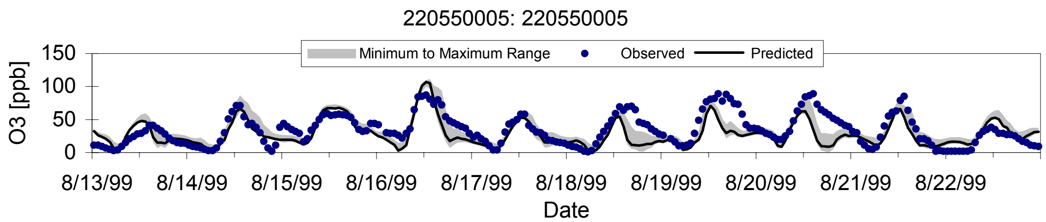
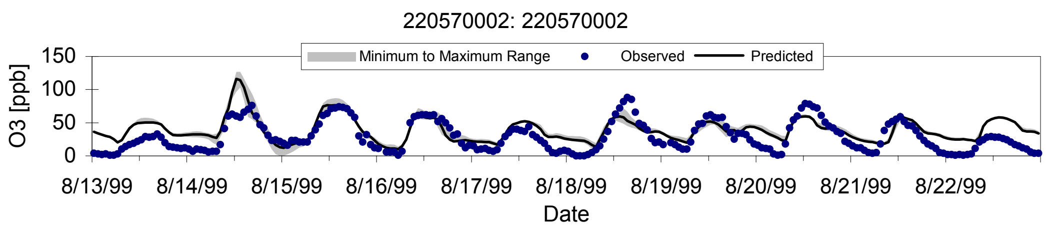
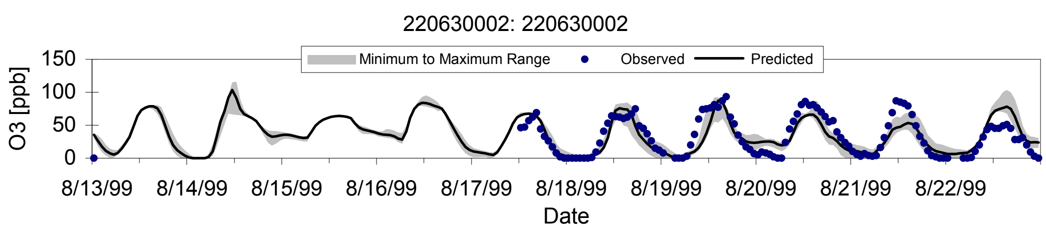


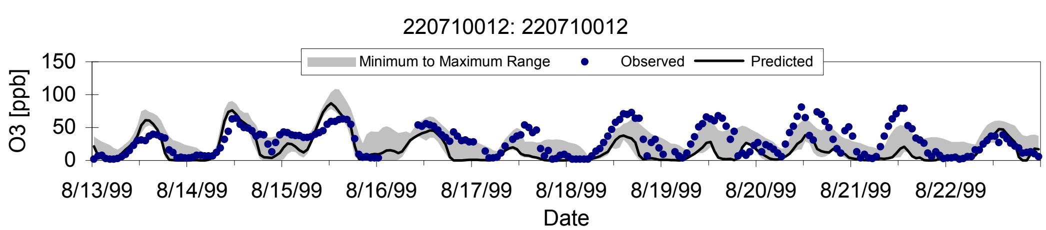
ETCOG 12-km Grid: Base Case 7

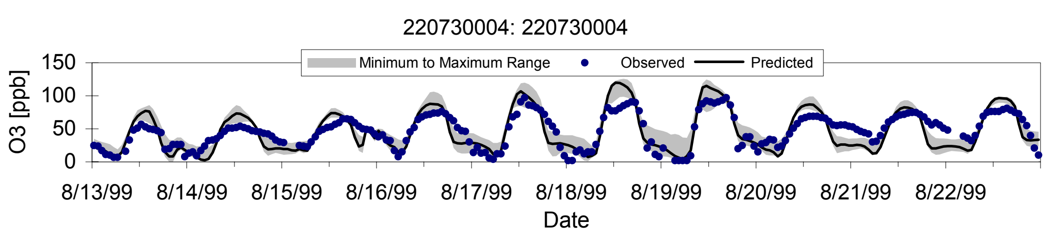




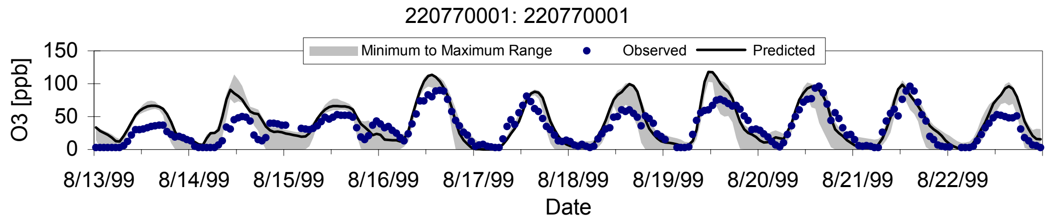


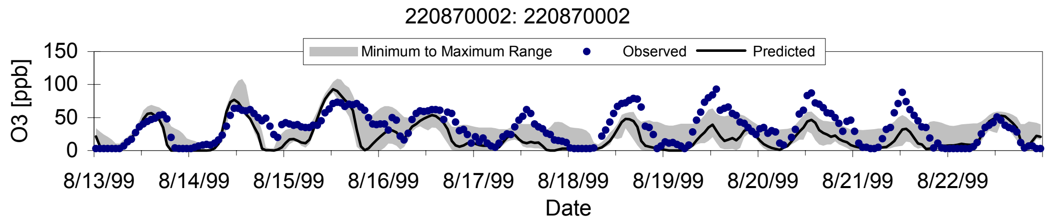


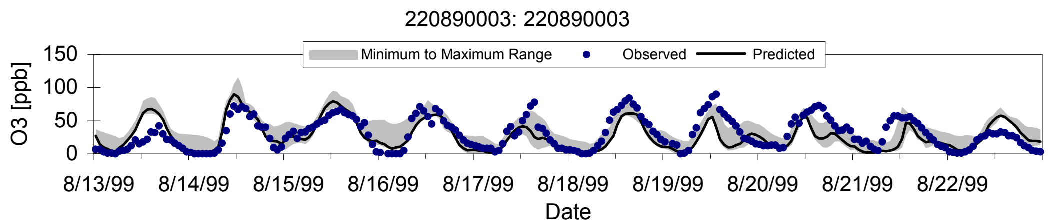


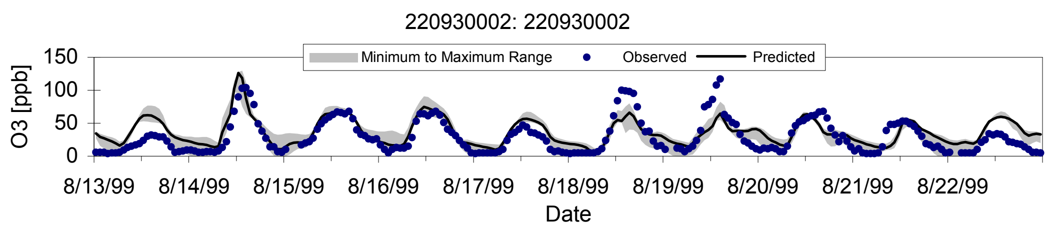


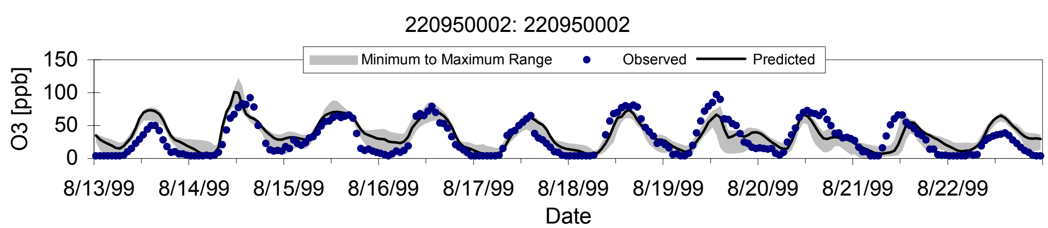
ETCOG 12-km Grid: Base Case 7

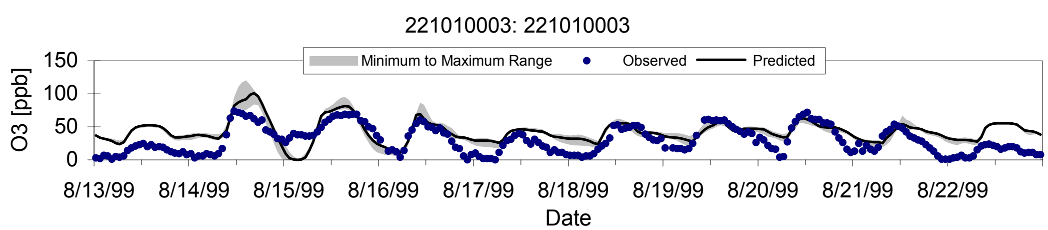












ETCOG 12-km Grid: Base Case 7

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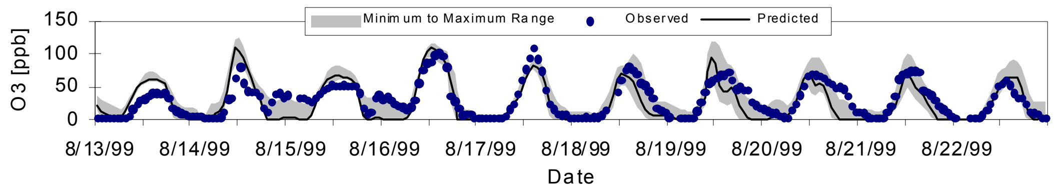

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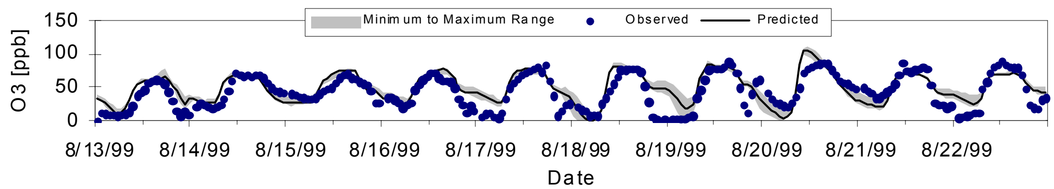

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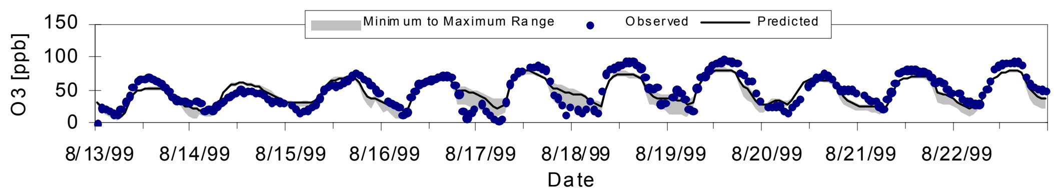

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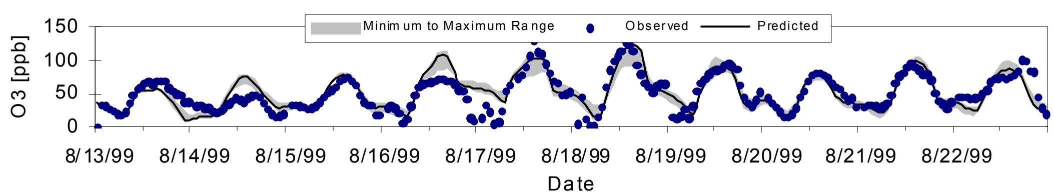

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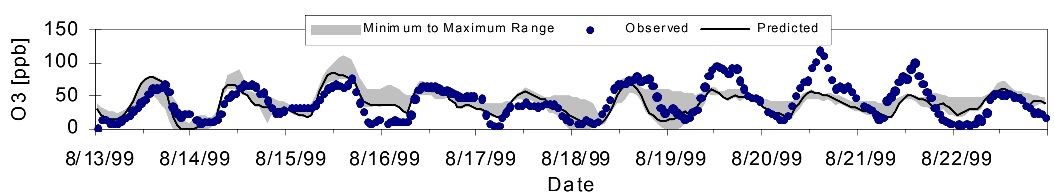

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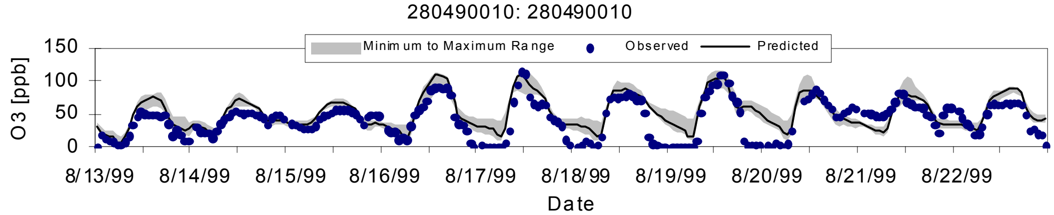
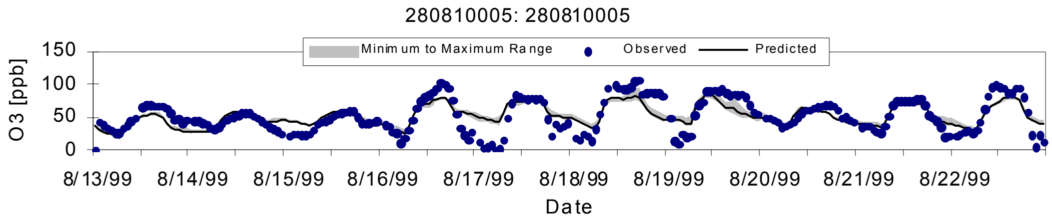
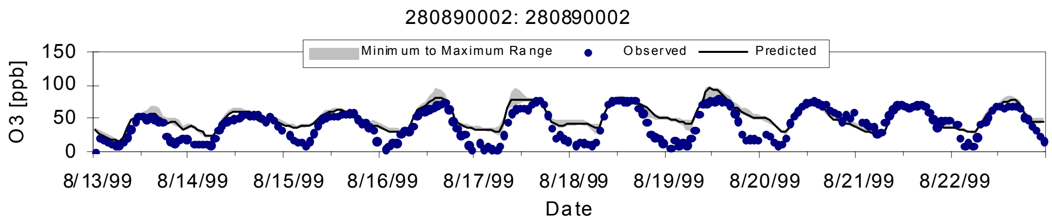
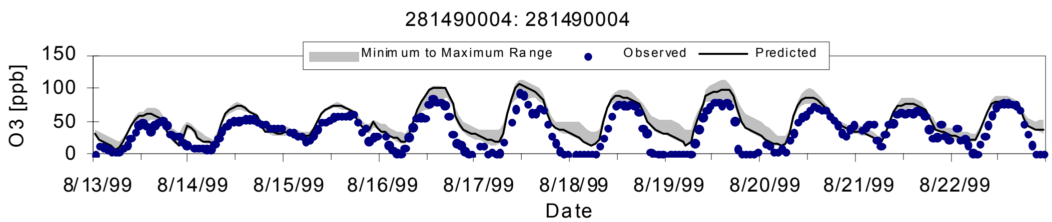
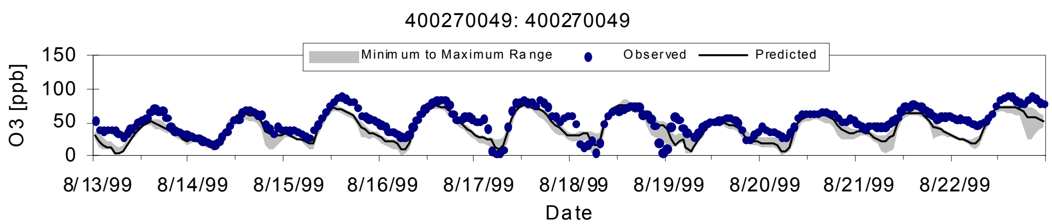


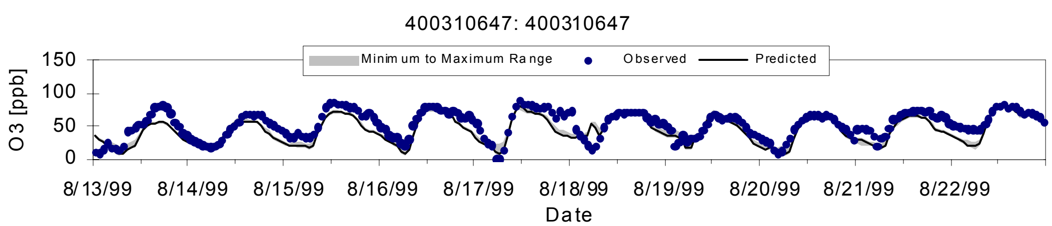
ETCOG 12-km Grid: Base Case 7

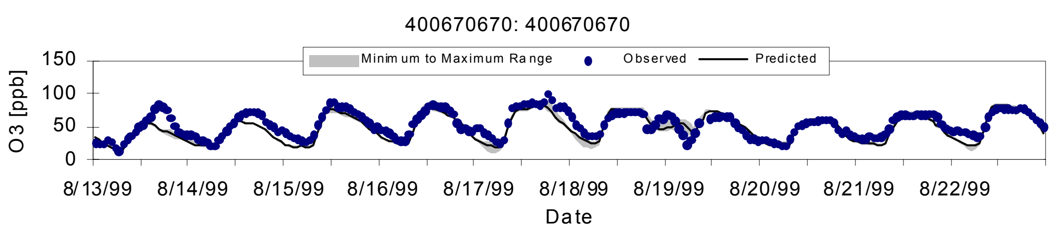




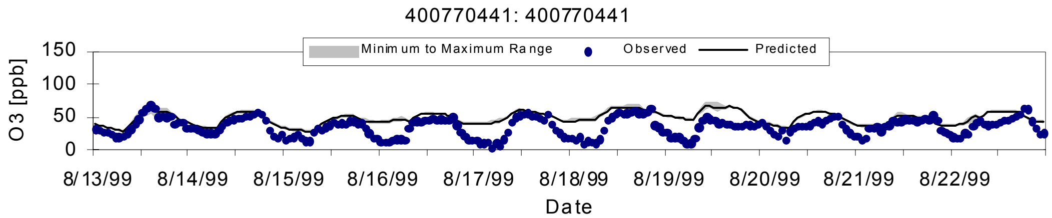


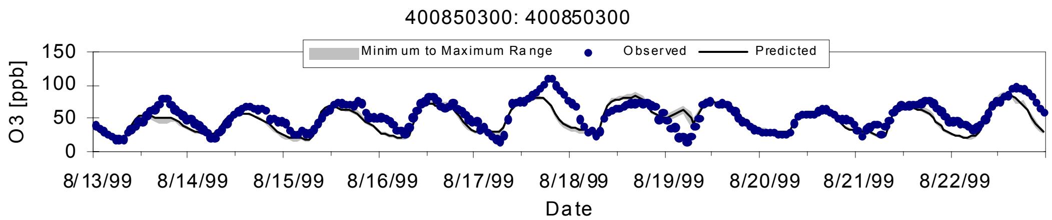


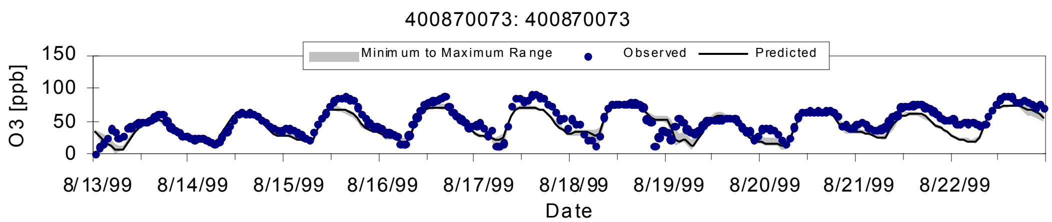


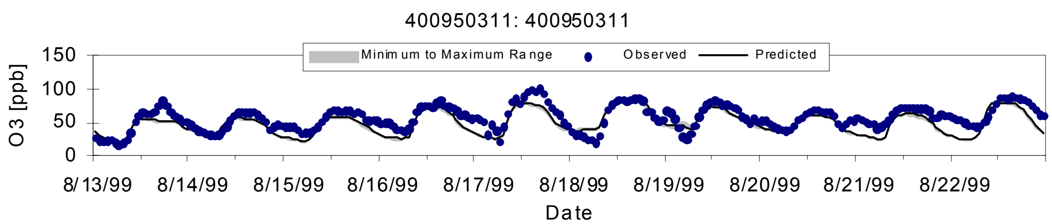


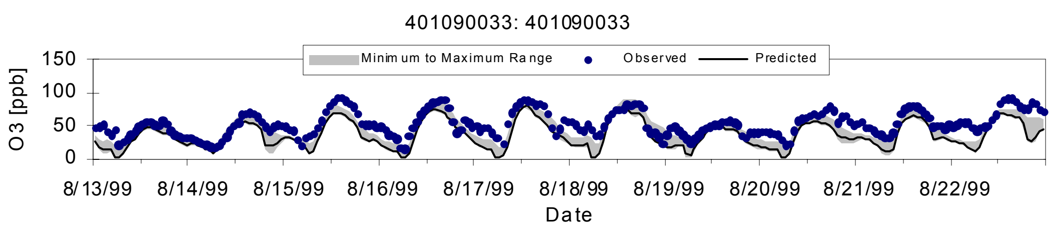
ETCOG 12-km Grid: Base Case 7

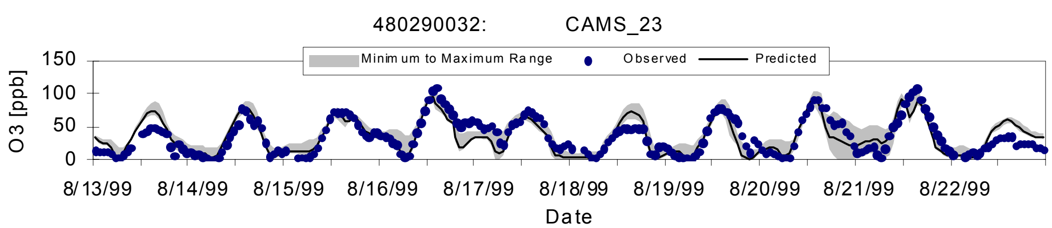












ETCOG 12-km Grid: Base Case 7

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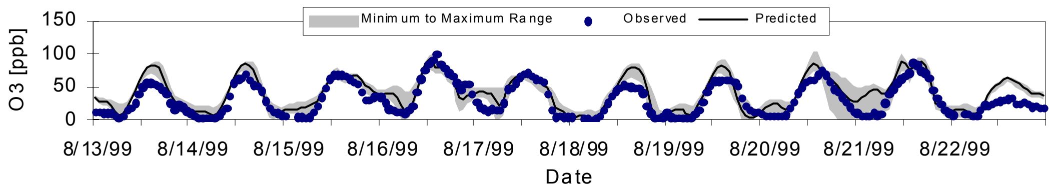

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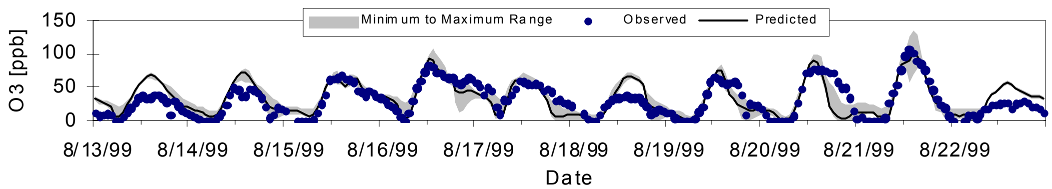

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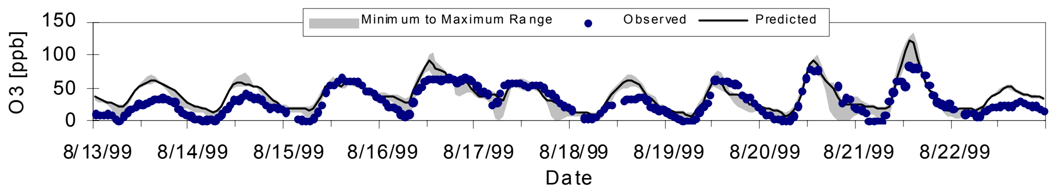

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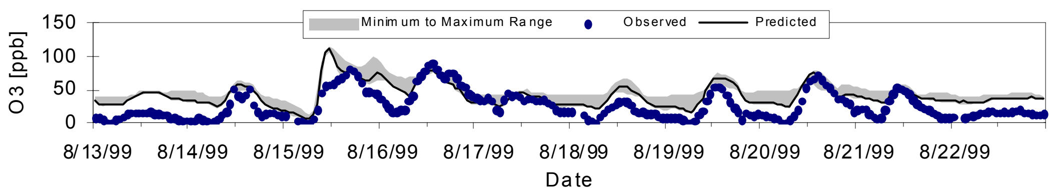

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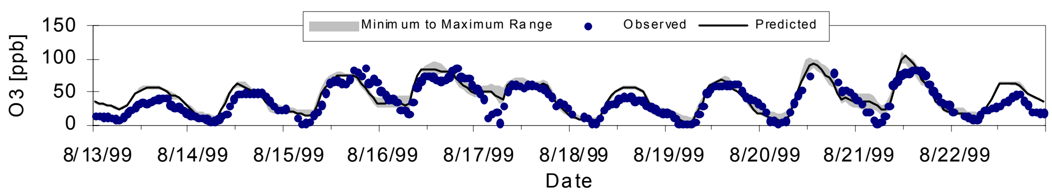

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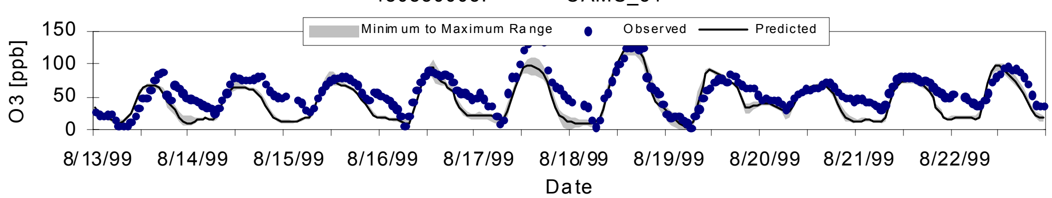

ETCOG 12-km Grid: Base Case 7

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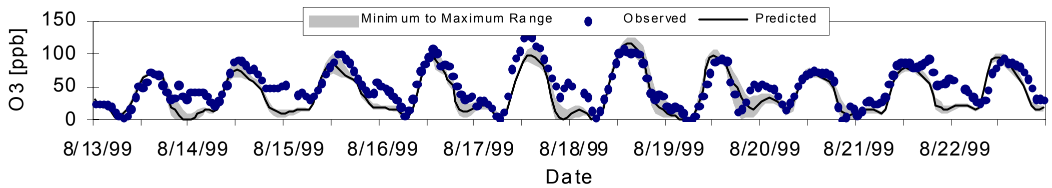

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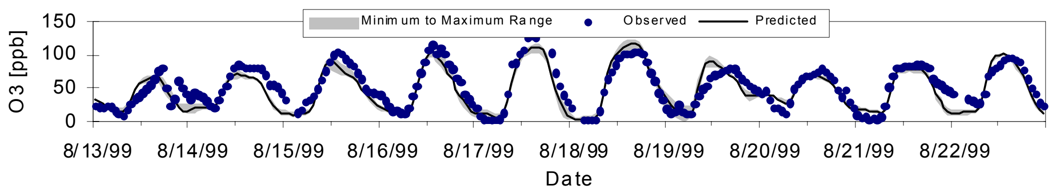

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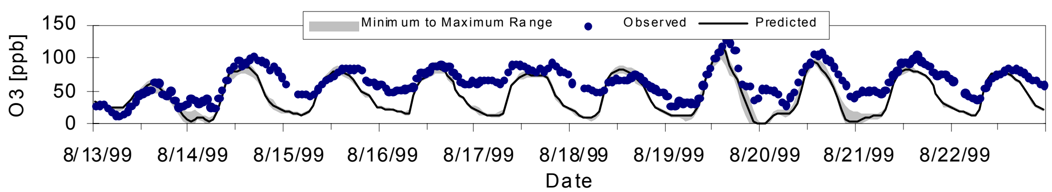

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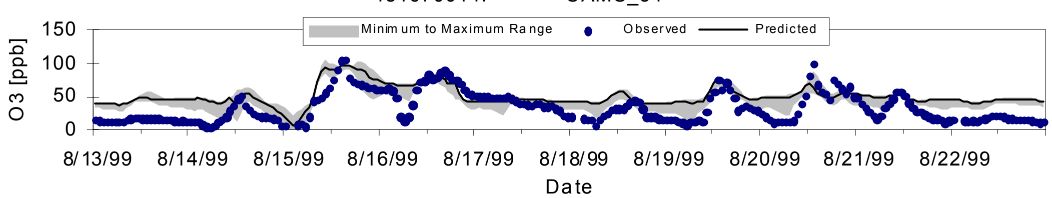

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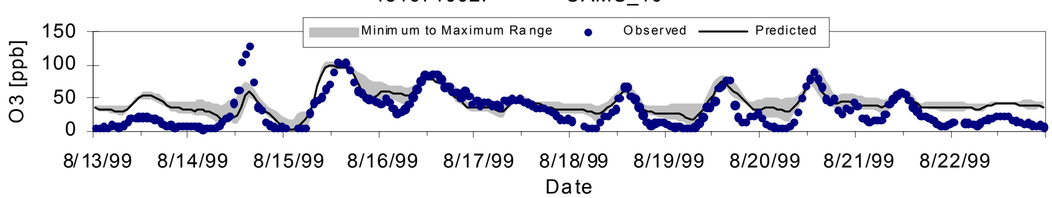

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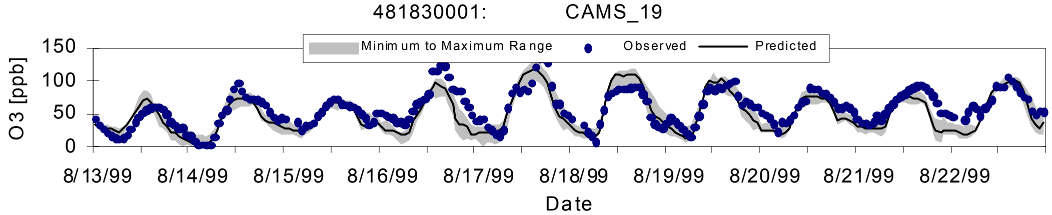
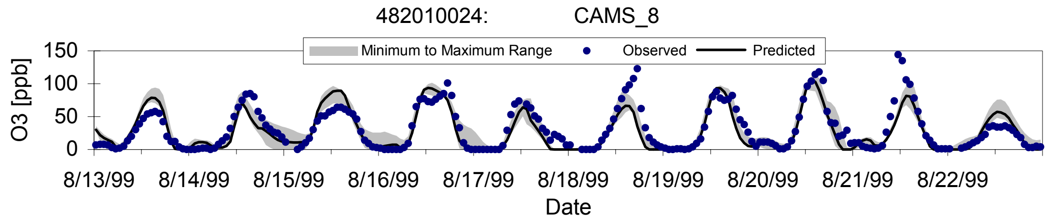
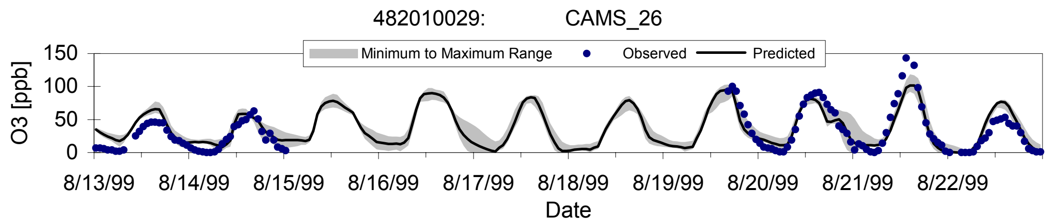
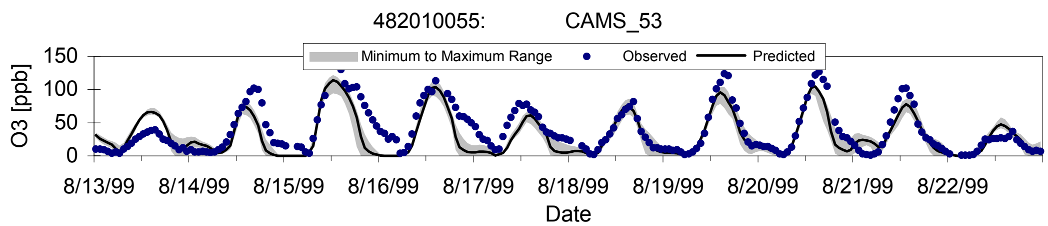
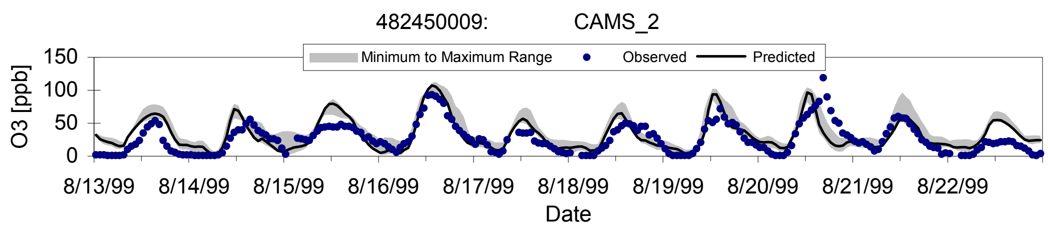


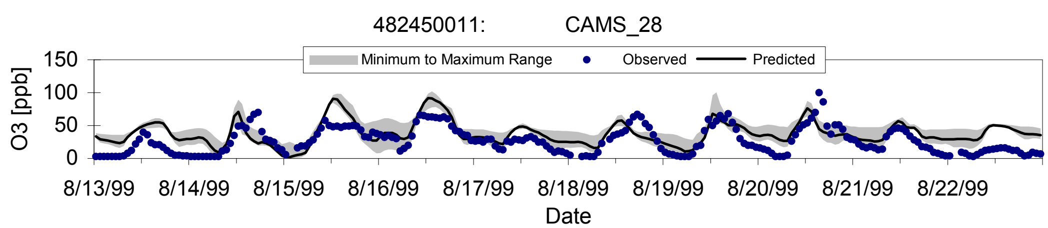
ETCOG 12-km Grid: Base Case 7

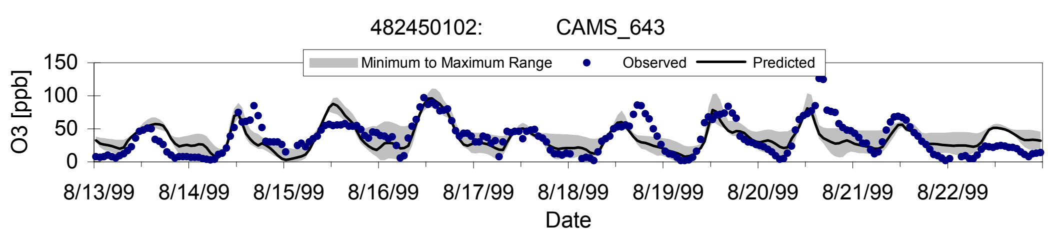












ETCOG 12-km Grid: Base Case 7

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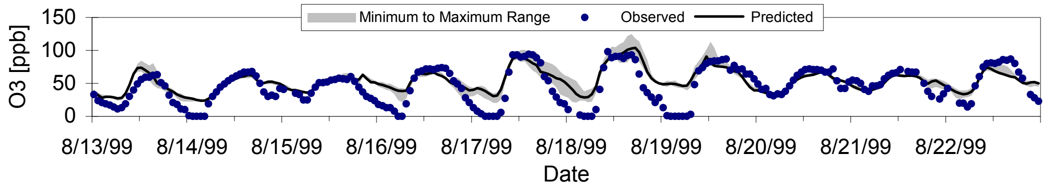

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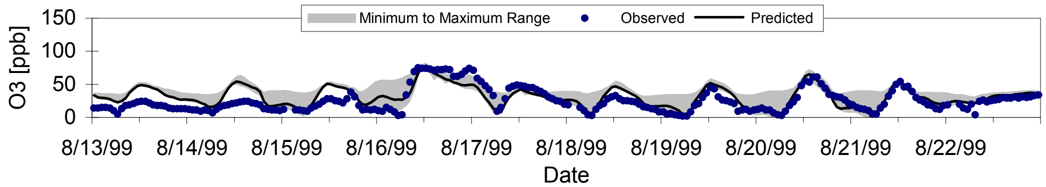

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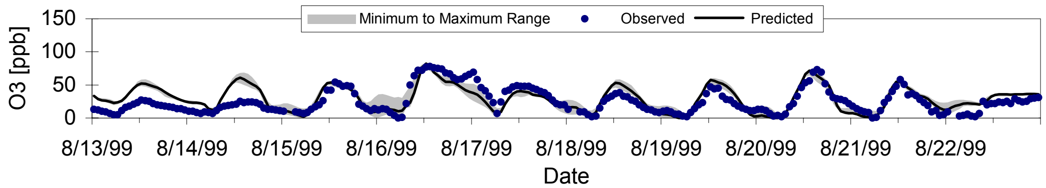

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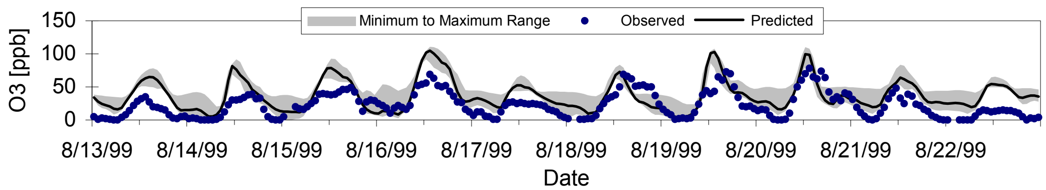

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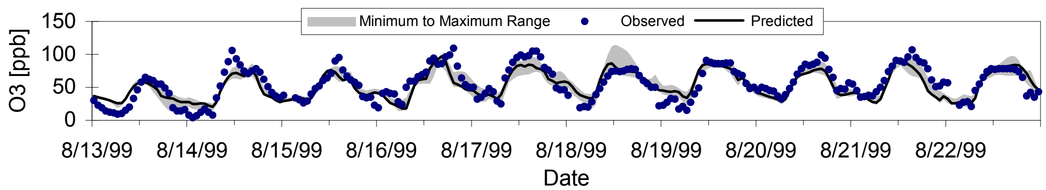

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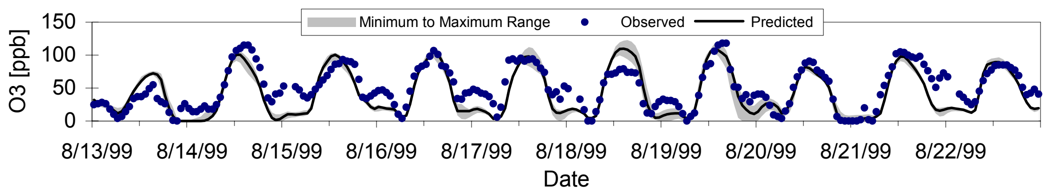
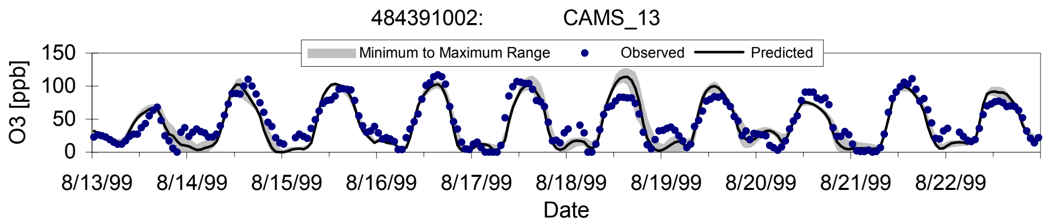
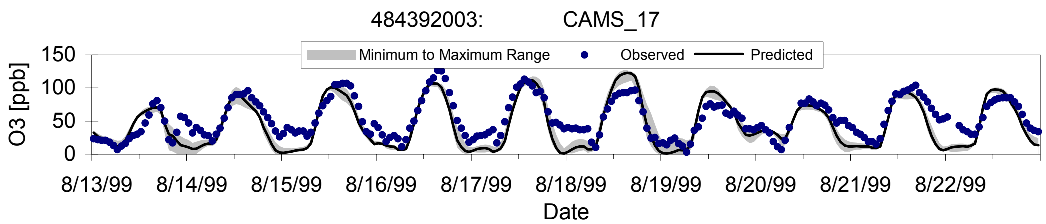
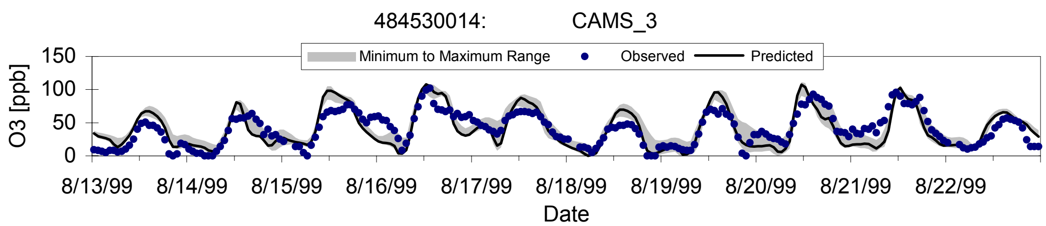
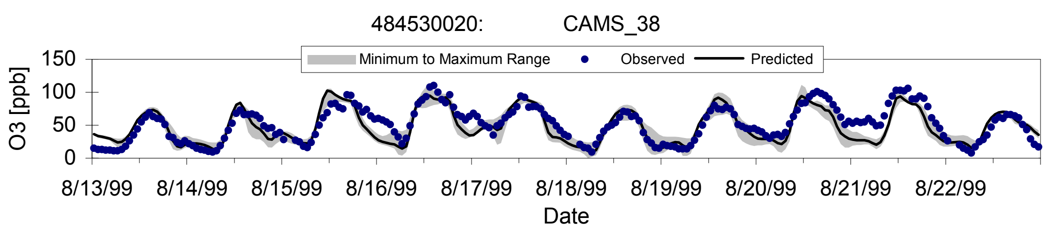


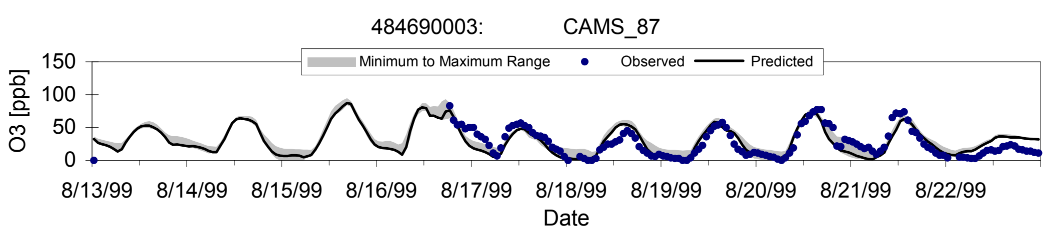
ETCOG 12-km Grid: Base Case 7

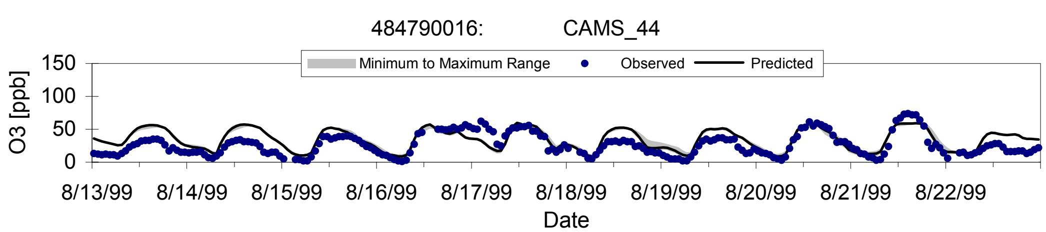








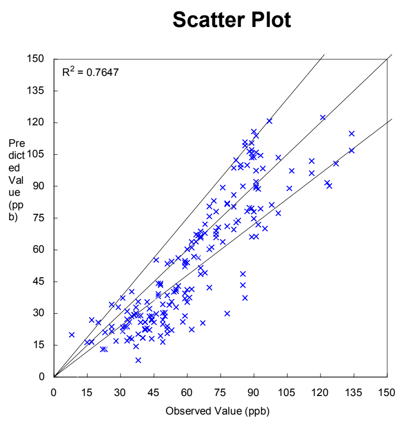




APPENDIX G

Scatter Plots of Estimated and Observed 1-Hour Ozone (ppb)
for AIRS Monitors in the 4-km Grid for the
August 15-22, 1999 Episode: 1999 Base Case 7

Longview



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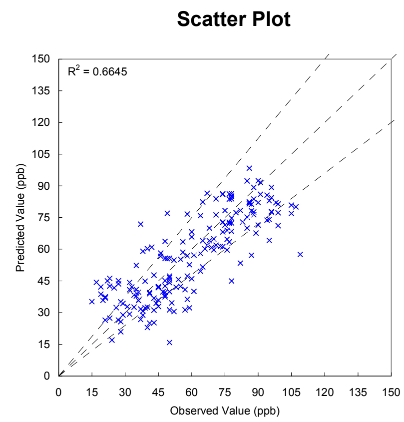
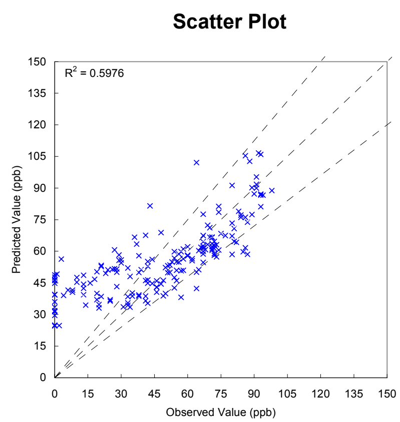


Cypress River



All monitors

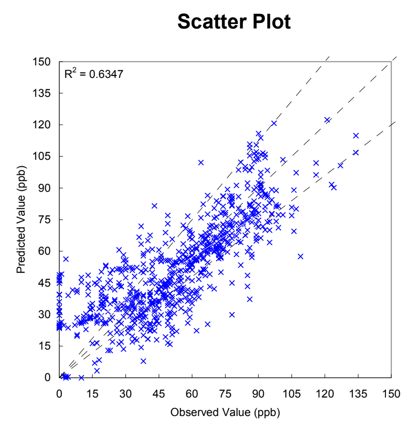


Table G-1. Scatter Plots of Estimated and Observed 1-Hour Ozone (ppb) for AIRS Monitors in the 4-km Grid for the August 15-22, 1999 Episode: 1999 Base Case 7.

APPENDIX H

Scatter Plots and Quantile-Quantile Plots of Daily Maximum 1-Hour Ozone (ppb) for
AIRS Monitors in Northeast Texas for the
August 15-22, 1999 Episode: 1999 Base Case 7

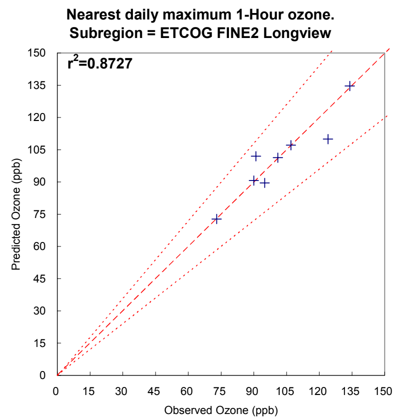
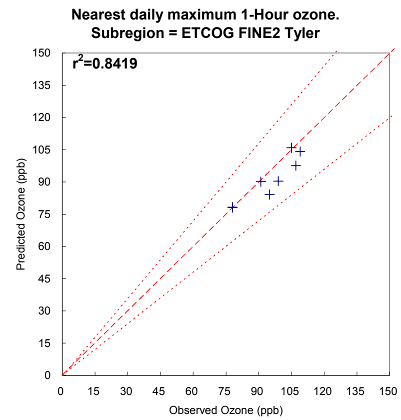
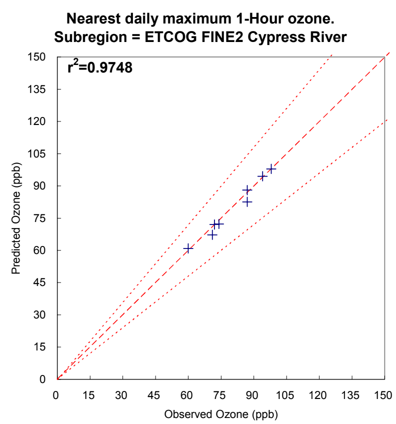
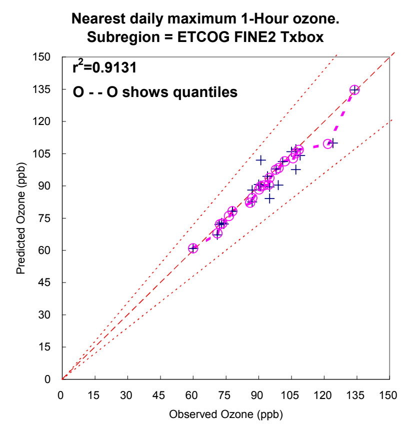
Longview	Tyler
	
Cypress River	**All monitors**
	

Table H-1. Scatter Plots and Quantile-Quantile Plots of daily Maximum 1-Hour Ozone (ppb) for AIRS Monitors in Northeast Texas for the August 15-22, 1999 Episode: 1999 Base Case 7. Quantiles are not shown for individual monitors because there are two few data.

APPENDIX I

Model Performance Statistics for 1-Hour Ozone (ppb) for AIRS Monitors in the 4-km Grid for the August 15-22, 1999 Episode: 1999 Base Case 7

Table I-1. Model performance statistics for 1-hour ozone for all AIRS monitors in Northeast Texas.

Stats	99/08/15	99/08/16	99/08/17	99/08/18	99/08/19	99/08/20	99/08/21	99/08/22
Bias (normalized)	-4.5%	-18.0%	-6.9%	12.6%	-6.4%	-12.3%	-17.4%	-4.0%
Bias (fractional)	-5.4%	-21.6%	-8.1%	11.1%	-7.7%	-13.6%	-21.3%	-6.1%
Error (normalized)	9.5%	19.7%	13.4%	14.9%	12.2%	13.3%	18.6%	14.1%
Error (fractional)	10.1%	23.1%	14.0%	13.4%	13.1%	14.5%	22.4%	15.5%

Table I-2. Model performance statistics for 1-hour ozone by monitor over all days.

Stats	Longview	Cypress River	Tyler
Bias (normalized)	-4.4%	-6.8%	-5.6%
Bias (fractional)	-7.5%	-8.3%	-6.9%
Error (normalized)	17.3%	13.5%	12.4%
Error (fractional)	19.3%	14.1%	13.2%

A cutoff of 60ppb was used.

APPENDIX J

Scatter Plots of Estimated and Observed 8-Hour Ozone (ppb) for
AIRS Monitors in the 4-km Grid for the
August 15-22, 1999 Episode: 1999 Base Case 7

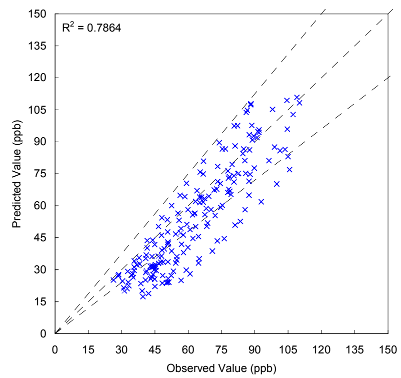
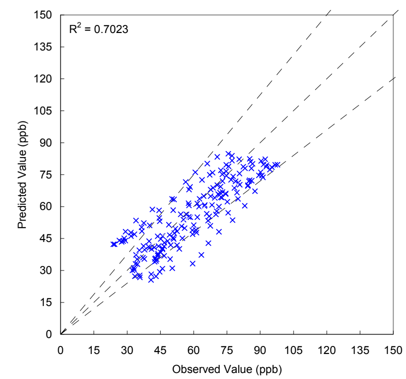
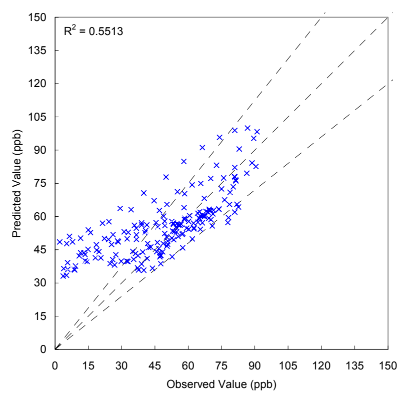
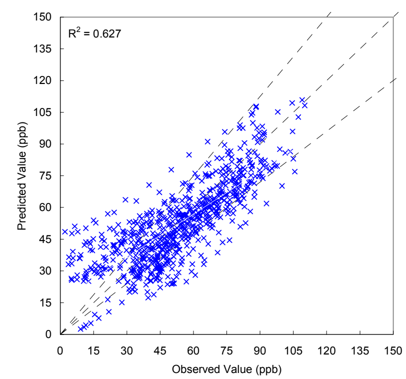
Longview	Tyler
Scatter Plot  	Scatter Plot 
Cypress River	**All monitors**
Scatter Plots  	**Scatter Plot** 

Table J-1. Scatter Plots of Estimated and Observed 1-Hour Ozone (ppb) for AIRS Monitors in the 4-km Grid for the August 15-22, 1999 Episode: 1999 Base Case 7.

Appendix K:

Quantile-Quantile Plots of 8-Hour Ozone (ppb) for
AIRS Monitors in the 4-km Grid for the
August 15-22, 1999 Episode: 1999 Base Case 7

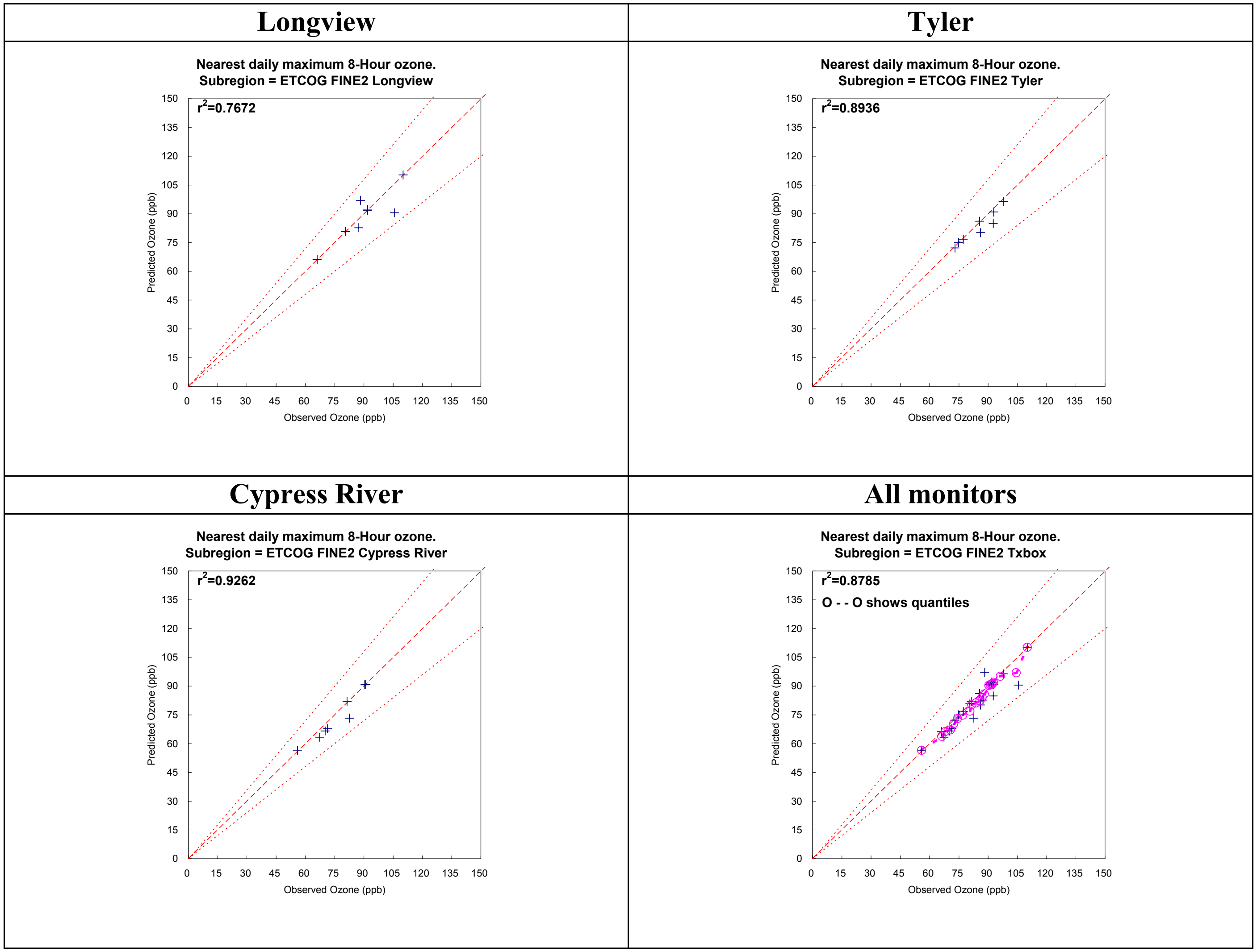


Table K-1. Scatter plots and Quantile-Quantile Plots of daily maximum 8-hour Ozone (ppb) for AIRS Monitors in Northeast Texas for the August 15-22, 1999 Episode: 1999 Base Case 7. Quantiles are not shown for individual monitors because there are two few data.

Appendix L:

Model Performance Statistics for 8-Hour Ozone (ppb) for
AIRS Monitors in Northeast Texas for the
August 15-22, 1999 Episode: 1999 Base Case 7

Table L-1. Model performance statistics for 8-hour ozone over all AIRS monitors in Northeast by episode day.

Stats	99/08/15	99/08/16	99/08/17	99/08/18	99/08/19	99/08/20	99/08/21	99/08/22
Bias (normalized)	-8.6%	-18.5%	-6.4%	14.0%	-5.2%	-13.3%	-20.4%	-3.9%
Bias (fractional)	-9.2%	-21.1%	-7.1%	12.7%	-5.9%	-14.5%	-24.2%	-4.9%
Error (normalized)	8.6%	18.5%	10.0%	14.2%	8.9%	13.3%	20.4%	10.8%
Error (fractional)	9.2%	21.1%	10.6%	12.9%	9.4%	14.5%	24.2%	11.3%

Table L-2. Model performance statistics for 8-hour ozone over all episode days by AIRS monitor in Northeast Texas.

Stats	Longview	Cypress River	Tyler
Bias (normalized)	-7.7%	-5.4%	-6.4%
Bias (fractional)	-9.9%	-6.5%	-7.6%
Error (normalized)	15.1%	13.1%	11.7%
Error (fractional)	16.7%	13.5%	12.6%